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OF

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VOL. XXVIII

Geographic Distribution of Pupillidae; Strobilopsidae, Valloniidae and Pleurodiscidae

BY

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Review of the anatomy of Pupillidae and related groups
By H. Burrington Baker

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PREFACE

In this final volume treating of the Pupillidae and allied families their geographic distribution has been discussed, with lists of the species of the several zoogeographic provinces, given for the convenience of those concerned with local faunas.

The classification of Pupillidae and their allies, formerly based almost wholly upon the shells, has been in large part placed upon a more satisfactory basis by the admirable anatomical work of C.-M. Steenberg, Hugh Watson and others, which appeared during the progress of the present monograph. Further data contributed by H. Burrington Baker are now presented in pages 191-209, plates 26-28. A revision of the classification of the Pupillidae into subfamilies, according to the present views of the author, will be found in the Introduction, pages vii-xii.

I am indebted to Dr. E. Degner, of the Zoologische Staatsinstitut u. Zoologische Museum, Hamburg, for compiling numerous names omitted from the indices of volumes 24-26. These have been supplied in the index of vol. 27.

H. A. Pilsbry.

Philadelphia, October 10, 1935.

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INTRODUCTION

The division of the Orthurethra into families seems to be largely a matter of expediency. Hugh Watson (1920), after showing that the various anatomical characters occur in a great number of combinations, suggested that the entire series be merged into three families, Achatinellidae, Partulidae and Pupillidae, the latter with numerous subfamilies. Steenberg (1925), with more analytical tendencies, proposed to recognize 16 families. The failure to find exclusive character-combinations for families has concerned me since 1900, when the snails composing the group Orthurethra were first brought together. The division into ten families in this Manual had its basis in (1) the recognition of features of the shell as important family characters, and (2) the idea that penial complications are fundamental, apparently present in the group as it was before breaking up into most of the existing families, and thus inherited in nearly all of them. Forms with simple genitalia are therefore relatively evolved and have arisen *de novo* in various families—a view which has been already either admitted or assumed by several authors. To believe that similar penial complications have arisen in several obviously distinct lines seems to stretch the probabilities of homoplasy too far.

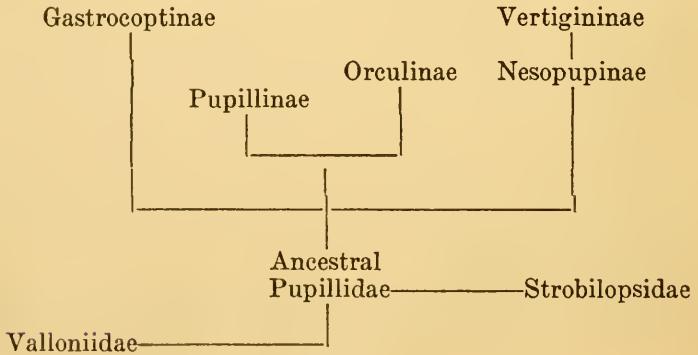
Apertural teeth or lamellae in the shell appear to have evolved after the initial divergence of the family stocks, as they do not seem to be traceable to any common type. The Pupillidae, Cochlicopidae, Tornatellinidae, Partulidae, etc. apparently each evolved its special type of apertural armature independently. In some families, such as Pupillidae and Tornatellinidae, this evolution appears to have been very early, and many members now show degeneration of teeth. In others, such as Partulidae and the genus *Spelaeodiscus* in Valloniidae, the evolution of teeth seems to have been one of the latest developments.

The family Pupillidae and its subfamilies.—The Pupillidae are characterized by the oval to cylindric shape of the shell,

with typically five laminae or teeth within: angular, parietal, columellar, upper and lower palatal, no marginal teeth on the peristome. The shape of the shell is changed in some genera, but not especially in the direction of other families of Orthurethra. From the strict homologies of the five primary teeth throughout the family it seems likely that the original pupillid stock possessed them; but in all of the derivative lines of descent (subfamilies) there are forms with the full tooth formula, together with others, in which there has been simplification or total loss of teeth.

In the collateral family Valloniidae there is no evidence of a five-plicate aperture in any of the living or fossil forms, though two of the leading genera are known in numerous species from the Paleocene to the present time. The character of being toothless from the earliest appearance has not I think, been sufficiently appreciated by those who would unite the Valloniidae with Pupillidae or Strobilopsidae. The only dentate genus, *Spelaediscus*, has teeth of a type wholly different from Pupillidae, and which may reasonably be regarded as newly arisen in that genus. The Strobilopsidae have a complicated system of internal laminae, already developed in the Eocene and persisting with little change to the present. I have elsewhere mentioned the possibility of homologizing the principal elements of this armature with pupillid teeth.

The interrelations of the subfamilies of Pupillidae, as I understand them, may be represented in a diagram, thus:



The upper subfamilies in this diagram are relatively evolved groups which have lost penial accessories. In Pupillidae I fail to trace any relation whatever between penial complication and the development of apertural armature, since four of the five subfamilies contain forms with highly complicated, together with others having toothless apertures.

Subfamily GASTROCOPTINAE.

Gastrocoptinae PILSBRY, 1918, p. x. Includes *Chrondrinidae* STEENBERG, 1925, p. 201.

Shell varying from minute to the largest of the family, typically with 5 teeth, the angular and parietal more or less converging or concrescent; but varying to forms with many accessory teeth or with no teeth.

Animal oviparous, without penial accessory organs. Jaw as in Pupillinae;

This subfamily is retained in the limits assigned in Manual 1916-1918 except for the genus *Bothriopupa*, which was removed to the Vertigininae near *Nesopupa* in 1926 (vol. 27, p. 228).

The genera were originally classified in four series. Those of my fourth group had already been brought into sequence by Pfeiffer, 1878. Steenberg (1925) formed the family Chondrinidae for *Chondrina, Abida* and *Sandahlia*, which he dissected, but H. Burrington Baker in this volume has shown that *Gastrocopta* agrees essentially with the European genera mentioned.

In genera starred the genitalia have been examined.

1. Gibbulina, 24:5. Chaenaxis, 24:1. *Gastrocopta, 24:6.

2. Hypselostoma, 24:175. Boysidia, 24:192. Gyliotrachela, 24:210.

3. Aulacospira, 24:220. Systenostoma, 24:224.

4. Fauxulus, 24:234. Odontocyclas, 24:254. *Sandahlia, 24:250. *Abida, 24:262. Granopupa, 24:332. *Chondrina (Modicella), 25:1; 27:283.

Dr. H. B. Baker contends that the name *Chondrina* is inadmissible under the rules, and should yield to *Modicella*; see page 203.

Subfamily Pupillinae.

Pupillinae Pilsbry, 1918, vol. 24, p. x; p. 106 + *Orculinae*, part. *Pupillidae* Steenberg, 1925, p. 201.

The shell is cylindric or tapering, of medium size for the family, with teeth varying from fully developed (*Leiostyla*) to wanting (*Pupoides*).

Animal either oviparous or viviparous. Penis bifid, with a long appendix and a forked retractor; spermathecal duct short or medium, often with a diverticulum. Jaw of very narrow, concrescent plates, producing a finely striate surface. Radula with central teeth tricuspid, as wide as the laterals or narrower; laterals bicuspid; marginals wide, with numerous narrow cusps.

The limits of this subfamily were materially extended by Steenberg's papers of 1925 and 1929, in which *Lauria* and *Agardhia* were shown to be like *Pupilla* in genitalia. Genera starred have been dissected.

*Pupoides, 26:103. *Pupoidopsis, 26:106: Microstele, 26:147. Microcerion, 26:151. *Pupilla, 26:152. *Lauria, 27:43. *Agardhia, 27:129. Paracoryna, 27:132, 320. Enneopupa, 27:222. ?Boysia, 26:225.

Subfamily Orculinae.

Orculinae Pilsbry, 1918, p. x. *Orculidae* Steenberg, 1925, p. 201. See also Hesse-Wiegmann, Archiv. Molluskenk. 56:1, and Soós, l. c. 57:94, for descriptions and figures of genitalia.

Animal oviparous. Penis terminating in a long blind sac beyond entrance of the epiphallus and retractor insertion; no appendix in *Orcula* and *Pagodulina*, but it is present in *Orculella*. Oviduct provided with a short cul-de-sac. Spermathecal duct long in *Orcula*, but short or medium in *Orculella*. Jaw and teeth about as in Pupillinae.

*Orcula, 27:1. *Orculella, 28:92. Pagodulina, 27:166.

This group is used in the limits established by Steenberg, who has also pointed out the close resemblance of Moquin-

Tandon's figure of the penis of *Pagodulina* to that of *Orcula*. The homologies of the penial appendages of *Orcula* and *Orculella* have been discussed by H. Burrington Baker, p. 201, whose conclusions appear well founded.

Orculella, distinguished from *Orcula* by the possession of an appendix, and a shorter spermathecal duct, does not appear to have any conspicuous differential shell characters. It is this group which approaches the Pupillinae closely, but has not the bifid penis or forked retractor.

Subfamily Nesopupinae.

Nesopupinae Steenberg, 1925, p. 201. For anatomy see H. B. Baker, p. 204.
Vertigininae, part, Pilsbry, 1920.

Shell and animal substantially like Vertigininae except that the penis bears an appendix and the retractor muscle is forked. Part of the genera are viviparous.

The genera composing the Nesopupinae had been grouped in a continuous series in my monograph of Vertigininae. Further anatomical work is needed to confirm the constancy of the differential characters of the two subfamilies, which are clearly more closely allied than either is to any other.

It is an old group of world-wide distribution in tropical and subtropical zones; it comprises a number of extinct genera, and is now largely replaced in northern continents by the Vertigininae, which were apparently derived from nesopupoid ancestors by simplification of the male organs. Starred genera have been dissected.

Campolaemus, 25:364. Staurodon, 25:224. Ptychalaea, 25:273; 27:225. *Lyropupa, 25:226. *Nesopupa, 25:274. Costigo, 25:336. *Pronesopupa, 26:1. *Bothriopupa, 24:226; 27:228. *Pupisoma, 26:19. Cylindrovertilla, 26:43. Sterkia, 26:49. Paracraticula, 27:221. Glandicula, 25:221. Pseudelix, 25:222.

The fifth to eighth genera of the above list are evidently closely allied, and whether all are generically distinct seems open to question. *Ptychalaea* may belong to the Vertigininae.

Subfamily Vertigininae.

Vertigininae Pilsbry, in part, vol. 25, p. 68.
Vertigininae and *Truncatellininae* Steenberg, 1925, p. 201.

Shell small or minute, usually brownish, compact, oval or cylindric; aperture with many teeth or none.

Animal oviparous, usually without tentacles. Penis simple, without appendages, the retractor muscle simple, attached to epiphallus. Hermaphrodite gland divided into two groups of short, wide acini. Male organs are frequently absent. Jaw formed by the concrescence of relatively few, wide plates separated by grooves. Central tooth tricuspid, laterals bi- or tricuspid with interstitial cusplets, the ectocone often about as long as the mesocone. Marginals usually tricuspid with numerous interstitial cusplets. The genera fall into two series. Genera starred have been dissected.

1. *Vertigo, 25:68.
2. *Truncatellina, 26:59. *Columella, 27:232.

Family *STROBILOPSIDÆ.*

Helicidæ and *Pupidæ* of various authors.

Strobilidæ Jooss, Jahrb. Nassauischen Vereins f. Naturkunde, LXIV, 1911, p. 61.

Strobilopsinæ Pilsbry, Man. Conch. XXIV, 1918, p. x.—Wenz, Fossilium Catalogus, Gastropoda Extramarina Tertiaria, pars 20, 1923, p. 1041.

Strobilopsidæ Hanna, Nautilus XXV, 1922, p. 91.—Steenberg, Études sur l'Anat. et la Syst. des Maillots, 1925, p. 202.

Shell trochiform, dome-shaped or discoidal, umbilicate, of 4½ to 6 slowly-enlarging whorls. The aperture is small, oblique, with armature of 2 or 3 parietal lamellæ and several deeply-placed basal folds, all growing continuously from an early neanic stage. Peristome more or less thickened and expanded, the ends of the lip remote, joined by a parietal callus.

Urethra lies very near the last part of the intestine. Ovotestis forms two groups of follicles. Penis is continued in a long epiphallus and bears a long appendix, with swollen basal and distal divisions, the penial retractor bifurcate, one branch inserted on the epiphallus, the other on the base of the appendix (distally it attaches to the right ocular retractor, according to Hanna). The jaw has numerous ribs. Radula with tricuspid central tooth with square basal plate, as large as the bicuspid laterals, the marginals multicuspid (Pl. 4, fig. 10).

By the structure of the male organs *Strobilops* resembles *Vallonia; Pupilla, Lauria,* the Achatinellidæ, and some other groups are similar in having a bifurcate penial retractor and a long, tripartite appendix. If Hanna is right in stating that the penial retractor is a branch of the right ocular band, this is an important difference from any known orthurethrous

group. The mouth parts do not differ materially from some Pupillidæ.

The shell, aside from its helicoid shape (not a character of great importance), differs from all Pupillidæ in the arrangement of the lamellæ and baso-palatal folds. In multidentate Pupillidæ the five primary teeth are always recognizable (see diagram in Vol. XXV, p. vii) while in *Strobilops* only the main parietal lamella and the columellar lamella can certainly be said to correspond, and these are found in so many other land shells that their occurrence is not especially significant. It is possible, however, that upper and lower palatal folds of Pupillidæ are represented by teeth 5 and 2 of fig. 1, and the basal fold by tooth 1.

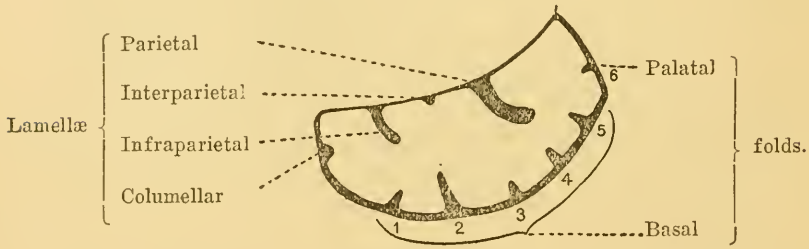


Fig. 1. Section of last whorl of *Strobilops* at the internal barrier, showing terminology of teeth.

By the accelerated lamellæ and folds of the shell, which appear early in the neanic stage, *Strobilops* resembles various Tornatellinidæ (Manual XXII). In that family both parietal and palatal folds or laminæ are sometimes present in the neanic stage. Various Pupillid genera also, such as *Orcula* and *Lauria*, have apertural armature during the neanic stage, described in this work, Vol. XXVII. *Orcula* has spiral parietal and columellar lamellæ but no basal or palatal folds. *Lauria* has basal folds, but they are spaced, *transverse* barriers, wholly unlike the adult basal or palatal armature of the species, and differing equally from the folds of immature *Strobilops*, which from their inception appear to develop continuously into those of the adult shell. It appears likely that

the acceleration or early appearance of apertural armature in Tornatellinidæ, *Orcula, Lauria* and *Strobilops* has been independent in the four groups, and is not indicative of direct relationship between any of them.

On the whole, I am inclined to rank the Strobilopsidæ as a family, distinguished chiefly by characters of the shell.

In the course of my work on the super-family Orthurethra in this Manual, the problem of defining family groups has constantly been before me. The partial solutions offered have not been wholly satisfactory to myself. The difficulties have been stated lucidly by Hugh Watson (Proc. Malac. Soc. London XIV, pp. 20-27; diagram on p. 25). He has called attention to the fact that a division of the Orthurethra based on any single character (such as the presence or absence of penial appendix or flagellum, single or forked penial retractor, presence of a diverticulum of the spermathecal duct, degree of elongation of the shell, etc.) would not accord with a division based upon any other characters. At present the relative value of these characters appears in most cases to be uncertain. That some forms have been simplified secondarily seems highly probable. Watson proposed that the Partulidæ and Achatinellidæ (including Tornatellinidæ as a subfamily) be retained as families, all the rest of the Orthurethra to be included in Pupillidæ under a number of subfamilies. He does not recognize characters of the shell as significant for family grouping, though the construction of his diagram appears to show that he relied upon them for his subfamily grouping. Steenberg, whose work, Études sur l'Anatomie et la Systématique des Maillots, 1925, is the most important document we have on Pupillid anatomy, would divide the Orthurethra into sixteen families.

Although the meaning of characters of the shell may become vague or illegible by degenerative changes, convergent evolution and the like, I am inclined to believe them somewhat more stable than the details of genitalia in these Orthurethra, and to utilize them in grouping the genera into families. To rank the Amastridæ, the Cochlicopidæ or even the Strobilopsidæ as subfamilies of Pupillidæ does not seem to me to clarify

our conceptions of this intricate group, though it is admitted that they are not strongly characterized families.

Paleontology.

Strobilopsidæ appeared in the Upper Eocene of western Europe in several species having all the external characters of the genus *Strobilops,* and though the internal structure has not been worked out, it is safe to assume that they are closely related to the well-known Oligocene forms following them. In Europe this genus continued in numerous species into the Pliocene, the last one in the Upper Pliocene (Astian stage) of Piedmont.

In late Cretaceous beds there are various forms described as *Helix,* or under the names *Obbinula* and *Pseudostrobilus,* which certainly have some of the characters of *Strobilops.* The poor preservation of the very small number of specimens yet found does not admit of a definite reference to this family; their position can only be cleared up by further material. All are larger than any *Strobilops.* Notes and references, with figures of the type species of these groups, follow the list of Tertiary species of *Strobilops.*

Genus Strobilops Pilsbry.

The following list is taken from that of W. Wenz, Fossilium Catalogus, Pt. 20, III, 1923, pp. 1041-1061, which must be consulted for full references to previous literature. A few minor alterations and additions have been derived from other sources.

Strobilops appeared in the upper Eocene in three species. Oligocene species are more numerous and their structure has been fully investigated. Some, such as *S. headonensis* and *S. pseudolabyrinthica,* carefully worked out by L. R. Cox, approximate rather closely to recent species of the typical *labyrinthica* group, having the interparietal lamella developed, the series of internal plicæ extending above the periphery, and the exterior costate. This group continued into the Pliocene, represented by several species, *S. romani* (pl. 12, figs. 11-13), *S. labyrinthicula* and others.

Two other series of species appeared first in the Oligocene, one, *Eostrobilops,* in which the surface is finely striate, beginning with *S. diptyx,* continuing to the Pliocene, *S. duvali.* The other series, *Discostrobilops,* contains *S. uniplicata* (pl. 8, figs. 10-13), which lived from the upper Oligocene to upper Miocene in various varietal forms, and is interesting for its great similarity to the living American *S. hubbardi.*

In Europe at its first appearance as now known, the complex structure of the genus was apparently about as fully evolved as in any modern species. In the Oligocene, the subdivisions *Strobilops* proper, *Eostrobilops* and *Discostrobilops* appeared in central Europe, typically developed, probably by migration from somewhere eastward.

Strobilops doubtless had a long Tertiary history in North America, still to be recovered. At present it is not known here below the Pleistocene. *S. labyrinthica* has been identified from several Pleistocene deposits, the earliest an Iowa deposit believed to be of Aftonian age. *S. affinis* and *S. labyrinthica* occur from the Sangemon on to the Recent, according to records assembled by F. C. Baker. All of the Pleistocene localities are within the areas still inhabited by these species. In Bermuda *S. hubbardi* occurs in Pleistocene lime rock (consolidated dune formation) and later cave deposits, up to Recent.

The list of Tertiary species follows. For their classification see p. 16.

STROBILOPS BOETTGERI (Andreae). *Strobilus boettgeri* ANDREAE, Mitt. a. d. Roemer Museum, Hildesheim, No. 18, pp. 5, 10, 26, text-fig. 5. — *Strobilops boettgeri* WENZ, N. Jahrb. f. Min., Geol. u. Pal., 1915, II, p. 80, pl. 4, f. 4*a-c*; text-fig. 8. Upper Miocene, Tortonian: Oppeln, Silesia.

STROBILOPS COSTATA (Clessin). *Strobilus costatus* CLESSIN, Corresp.-bl. Zool. Min. Ver. Regensburg, 1877, p. 37.—*Strobilops costata* WENZ, N. Jahrb. Min., Geol. u. Pal. 1915, p. 79, pl. 4, f. 15*a-c*; text-fig. 7. — *Strobilus bilamellatus* CLESSIN, Malak. Blätter, n. F. VII, 1885, p. 79, pl. 7, f. 10.—*Strobilus curdoofensis* CLESSIN, Bericht Naturwiss. Ver. Regensburg, XIII (1912), p. 104 = *Strobilus undorfensis* CLESSIN, t. c.,

p. 112. Miocene, Tortonian: Undorf bei Regensburg; Oppeln, Silesia.

STROBILOPS DESMARESTINA (Brong.). *Helix desmarestina* BRONGNIART, Ann. du Mus. d'Hist. Nat. XV, 1810, p. 380, pl. 23, f. 10.—*Strobilops desmarestina* WENZ, Foss. Cat., pt. 20, III, 1923, p. 1042. Upper Oligocene, Chattian: Palaisean and Montmorency; Etampes. Insufficiently known.

STROBILOPS DIPTYX (Boettger). *Helix diptyx* BOETTGER, Beitrag paleont. geol. Kenntnis Tertiärform. in Hessen, 1869, p. 24, pl. 1, f. 5. — *Strobilops diptyx* WENZ, N. Jahrb. Min. Geol., Pal. 1915, II, p. 75, pl. 4, f. 6*a-c*; text-fig. 3.—*Strobilus clyptyx* KLEBS, Jahrb. Kön. Preuss. Geol. Reichsanst. 1885 (1886), p. 378. Upper Oligocene, Chattian: Offenbach a. M.; Hochheim-Flörsheim (Hessen-Nassau).

STROBILOPS DIPTYX SUPREMA Wenz. *Strobilops diptyx* var. *suprema* WENZ, Jahresber. u. Mittheil. d. Oberrhein. Geol. Ver., n. f. V, 2, p. 175. Foss. Cat., 1923, p. 1045. Upper Miocene, Aquitanian: Donaurieden, Württemberg.

STROBILOPS DOLLFUSI (Collot). *Pitys dollfusi* COLLOT, Feuille Jeunes Naturalistes (5), XLI, 1911, p. 93, f. 1. — *Strobilops dollfusi* WENZ, Foss. Cat. 1923, p. 1045. Miocene, Vindobonian: Manthelan (Dép. Indre-et-Loire).

STROBILOPS DUVALI (Michaud). *Helix duvalii* MICHAUD, Journ. de Conchyl. X, 1862, p. 65, pl. 3, fig. 14-16.—*Strobilops duvali* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 82, text-fig. 11; pl. 4, f. 2*a-c*. Middle Pliocene, Plaicensian: Celleneuve near Montpellier and Montpellier (Dép. Herault); Hauterive (Dép. Drôme); Trevoux (Dép. Ain).

STROBILOPS ELASMODONTA (Reuss). *Helix* (*Conulus*) *elasmodonta* REUSS, Sitz.-Ber. Akad. Wissensch. Wien, Math.-Nat. Cl., XLII, 1860, p. 66, pl. 1, f. 2. — *Strobilops elasmodonta* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 77, text-fig. 5, pl. 4, f. 7*a-c*. Lower Miocene, Burdigalien: Kolnsoruk, Lipen and Tuchorshitz, Czechoslovakia.

STROBILOPS FISCHERI Wenz. *Strobilus diptyx* KLIKA, Archiv naturwiss. Landesdurchforschung Böhmen, VII, 1891, p. 34, text-fig. 26*a-c*. Not of Boettger. — *Strobilops fischeri* WENZ, Jahrb. Nassau. Ver. Naturk. in Wiesbaden, LXVII, p. 107;

N. Jahrb. Min. Geol., Pal., 1915, p. 78, text-fig. 6, pl. 4, f. 5*a-c*. Lower Miocene, Burdigalian: Tuchorshitz, Czechoslovakia.

STROBILOPS GEDANENSIS (Klebs). *Strobilus gedanensis* KLEBS, Jahrb. kön. Preuss. geol. Landesanst., 1886, p. 374, pl. 17, f. 3*a-d*.—*Strobilops gedanensis* WENZ, Fossilium Catalogus, 1923, p. 1047. Lower Eocene: amber of eastern Prussia.

STROBILOPS HEADONENSIS (Edwards). *Helix headonensis* F. EDWARDS, Monogr. Eocene Moll. Palæontographical Soc. 1852, p. 70, pl. 11, f. 5*a-d*.—*Strobilops headonensis* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 73.—L. R. COX, Proc. Malac. Soc. London, XVII, 1926, pp. 50, 56, figs. 1-6. Upper Oligocene: Bembridge Limestone of Headon Hill and Whitecliff Bay.

STROBILOPS JOOSSI (Gottschick). *Strobilus costatus* K. MILLER, Jahresh. Ver. vaterl. Naturk. in Württemberg, LVI, 1900, p. 396, pl. 7, f. 8. Not of Clessin. — *Strobilus joossi* GOTTSCHICK, same serial, LXVII, 1911, pp. 502, 533, pl. 7, f. 16*a-c*. —*Strobilops joossi* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 80, text-fig. 9; pl. 4, f. 14*a-c*. Upper Miocene, Sarmatian: Steinheim am Albuch, Württemberg.

STROBILOPS LABASSETIERI (de Morgan). *Helix* (*Anchistoma*, *Strobila*) *La Bassetieri* J. DE MORGAN, Bull. Soc. Geol. France (4), XIX, Nov. 1920, p. 313, fig. 8. Miocene: Faluns de Touraine, Charenton près de Pont-Levoy.

STROBILOPS LABYRINTHICULA (Michaud). *Helix labyrinthicula* MICHAUD, Actes Soc. Linn. Lyon II, 1854-5, p. 43, pl. 5, f. 4, 5.—*Strobilops labyrinthicula* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 82, text-fig. 10, pl. 4, f. 11*a-c*. Middle Pliocene, Plaicensian: Celleneuve and Montpellier (Dép. Hérault), Hauterive (Dép. Drôme), etc.

STROBILOPS MENARDI (Brong.). *Helix menardi* BRONGNIART, Ann. du Mus. d'Hist. Nat. XV, 1810, p. 380, pl. 23, f. 11.—*Helix* (*Strobila*) *pseudolabyrinthica* COSSMANN, Cat. Illustr. Coq. foss. l'Eoc. Env. Paris, IV, 1889, p. 360, pl. 12, f. 24-26. Not of Sandberger. — *Strobilops cossmanni* WENZ, N. Jahrb. Min., Geol., Pal. 1915, II, p. 74, pl. 4, f. 18*a-c*. — *Strobilops menardi* WENZ, Foss. Cat., 1923, p. 1050. Middle Eocene, Bartonian: Sables moyens de Bauchamp: Ducy, Montjavoult etc. (Dép. Oise) and other localities in Dép. Seine-et-Oise, Sarthe, Seine-et-Marne.

STROBILOPS MONILIA (Deshayes). *Helix monilia* DESH., Descript. Anim. s. Vert. Bassin Paris, II, 1863, p. 816, pl. 54, f. 4-7.—*Helix monile* SANDBERGER, Land- u. Süsswasser-Conch. de Vorwelt 1873, p. 258, pl. 14, f. 15.—*Helix monilis* HARRIS and BURROWS, Eocene and Oligocene Beds Paris Basin, 1891, p. 100.—*Strobilops monilia* WENZ, N. Jahrb. Min. Geol., Pal., 1915, II, p. 73, pl. 4, f. 17*a-c*.—*Strobilops monile* WENZ, Foss. Cat. 1923, p. 1051. Middle Eocene, Bartonian: Auvers and Beauchamp (Dép. Seine-et-Oise), etc.

STROBILOPS PATULIFORMIS (Sacco). *Helix* (*Gonostoma*) *patuliformis* SACCO, Mem. R. Accad. Sc. Torino, XXXVII, 1886, p. 191, pl. 1, f. 19*a-b*. — *Strobilops patuliformis* WENZ, Foss, Cat. 1923, p. 1052. Upper Pliocene, Astian: Fossano (Prov. Cuneo), Italy.

STROBILOPS PSEUDOLABYRINTHICA (Sandberger). *Helix pseudolabyrinthica* Sandberger, Die Land- u. Süsswasser-Conchyl. der Vorwelt, 1873, p. 277, pl. 14, f. 25. — *Helix labyrinthica* S. V. WOOD, London Geol. Journ. I, 1847, p. 118.; EDWARDS, Monog. Eocene Moll., II, 1852, p. 67, pl. 10, f. 7*a-e*, and of many other authors. Not of Say. — *Strobilops pseudolabyrinthica* WENZ, N. Jahrb. Min., Geol., Pal., 1915, p. 73, pl. 4, f. 19*a-c*, 20*c*.—COX, Proc. Malac. Soc. London, XVII, 1926, p. 51, 57, f. 7-9. Upper Oligocene, Tongrian: Lower Headon Beds, Totland Bay, Hordle; Headon Hill?; Melanienkalk at Brunnstadt, Flaclanden etc., Alsace.

STROBILOPS ROMANI Wenz. N. Jahrb. Min., Geol., Pal., 1915, II, p. 83, text-fig. 12, pl. 4, f. 12*a-c*. Middle Pliocene, Plaicensian: Hauterive (Dép. Drôme). Figured on pl. 12, figs. 11-13.

STROBILOPS SANDBERGERI (Lomnicki). *Strobilus lenticularis* SANDBERGER, Verhandl. k.-k. Geol. Reichsanst., Wien, 1885, p. 76, name only.—*Strobilus sandbergeri* LOMNICKI, same Verhandl., 1886, p. 421.—*Strobilops sandbergeri* WENZ, Fossilium, Catal., 1923, p. 1054. Upper Miocene, Tortonian: Folwarki, Steniatyn and Wyczolki, eastern Galicia. "Perhaps identical with *S. costatus*" (*Wenz*).

STROBILOPS SUBCONOIDEA (Jooss). *Strobilus subconoideus* Jooss, Nachrbl. d. Malak. Ges. XLIV, 1912, p. 34, pl. 2, f. 4.—

Strobilops subconoidea WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 81, pl. 4, f. 3*a-c*. Upper Miocene, Sarmatian: Steinheim am Albuch, Württemberg.

STROBILOPS TIARULA (Sandberger). *Strobilus tiarula* SANDB., Verhandl. k.-k. Geol. Reichsanstalt, Wien, 1886, p. 331.—*Strobilops tiarula* WENZ, Fossilium Catal., 1923, p. 1056; Senckenbergiana III, 1921, p. 32, fig. 4. Lower Pliocene, Pontian: Leolobersdorf, Kottingbrunn, Austria.

STROBILOPS UNIPLICATA (A. Braun). *Helix uniplicata* A. BRAUN, in Walchner, Handbuch der Geognosie, 2 Aufl., 1851, p. 1138.—*Strobilops uniplicata* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 76, fig. 4, pl. 4, f. 8*a-c*; Fossilium Catal. 1923, p. 1057. Upper Oligocene, Chattian: Hochheim-Flörsheim, Hesse-Nassau. Lower Miocene of Germany and Tuchorshitz, Czechoslovakia. Middle Miocene, Helvetian: Dettighofen near Eglisau, Canton Zürich.

STROBILOPS UNIPLICATA PLANA (Clessin). *Strobilus planus* CLESSIN, Malak. Blätter, n. F. VII, 1885, p. 80, pl. 7, f. 8.—*Strobilus diezi* CLESSIN, Bericht naturwiss. Ver. Regensburg, XIII (1912), p. 103. — *Strobilops uniplicata* var. *depressa* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 77, pl. 4, f. 10*a-c*. — *Strobilops uniplicata plana* WENZ, Fossilium Catal., 1923, p. 1059. Upper Miocene, Tortonian: Undorf near Regensburg, Steiermark; Hohenmemmingen, Württemberg.

STROBILOPS UNIPLICATA SESQUIPLICATA (Boettger). *Strobilus uniplicatus* var. *sesquiplicata* O. BTTG., Bericht Senckenbergische Naturf. Ges., Frankfurt a. M., 1884, p. 259.—*Strobilus uniplicatus* var. *semiplicata* K. FISCHER, Bericht Senckenb. naturf. Ges. 1904, p. 51. — *Strobilops uniplicata sesquiplicata* WENZ, N. Jahrb. Min., Geol., Pal., 1915, II, p. 77, pl. 4, f. 9*a-c*; Fossilium Catal. 1923, p. 1060. Lower Miocene, Aquitanian: Budenheim near Mainz, Wiesbaden. Upper Miocene, Tortonian: Frankfurt a. M.

Genus PSEUDOSTROBILUS Oppenheim.

Helix sect. *Pseudostrobilus* OPPENH., Zeitsch. d. Deutschen Geol. Gesellschaft, XLIV, 1892, p. 778.

In the Upper Cretaceous of Austria and Hungary several snails have been found which, though imperfectly known, appear to have some characters of *Strobilops*. The name *Pseudostrobilus* has been applied to them.

The shell is depressed, fragile, umbilicate, of 5 slowly increasing, costulate whorls. The lip is thickened, and on the parietal wall there are three strong entering lamellæ in the best known species and type of *Pseudostrobilus, P. riethmulleri,* pl. 12, figs. 7, 8. Diam. 5 mm. Nothing is known of internal teeth or folds within the basal lip.

PSEUDOSTROBILUS RIETHMULLERI (Tausch). *Helix riethmülleri* TAUSCH, Abhandl. k.-k. Geol. Reichsanstalt, XII, 1886, p. 14, pl. 2, f. 10, 11.—*Helix* (*Pseudostrobilus*) *riethmülleri* OPPENHEIM, Zeitsch. Deutschen Geol. Gesellsch., XLIV, 1892, p. 778. Non-marine beds of the Upper Cretaceous of the Csinger Valley near Ajka, Bakony, Hungary.

PSEUDOSTROBILUS AIGENENSIS (Tausch). *Helix aigenensis* TAUSCH, Abhandl. k.-k. Geol. Reichsanst., XII, 1886, p. 26, pl. 2, f. 12*a-b*. Cretaceous: Gosau marl of Aigen near Salzburg, Austria.

Genus OBBINULA Stache.

Obbinula STACHE, Abhandl. k.-k. Geol. Reichsanstalt, XIII, 1889, p. 119. Monotype *O. anthracophila* (Stache).

Thin, imperforate, flattened-conic, of 5 narrow, slowly increasing whorls, with fine, sharp growth-lines, with stronger ones at regular intervals; the earlier whorls somewhat more steeply conic. Aperture with two or three entering ridges. Type, *O anthracophila,* pl. 12, fig. 10. Diam. 4 mm.

OBBINULA ANTHRACOPHILA (Stache). *Helix anthracophila* STACHE, in Sandberger, Land- u. Süsswasser-Conchyl. Vorwelt, 1871, p. 129, pl. 19, f. 7*a-b*. — *Obbinula anthracophila* STACHE, Abhandl. k.-k. Geol. Reichsanst., XIII, 1889, p. 119, pl. 1, f. 26. — *cf.* OPPENHEIM, Zeitschr. Deutsch. Geol. Ges., XLIV, 1892, p. 779. "Cretaceo-Eocene" of Cosina, Dalmatia, in a coal layer of the *Stomatopsis* beds.

As Oppenheim has remarked, the accounts of this little fossil are conflicting; it *seems* to have apertural armature

somewhat like *Pseudostrobilus,* but it differs by being imperforate. Only a single, very much compressed example is known.

This genus and the preceding may possibly be related to *Dimorphoptychia.*

Mollusks erroneously referred to Strobilopsidæ, and non-molluscan forms.

DIMORPHOPTYCHIA Sandberger.

Dimorphoptychia Sandberger, Land- und Süsswasser-Conchyl. der Vorwelt, 1871, p. 149. Monotype *Helix arnouldi* Michaud. Rilly, Eocene.

H. arnouldi, pl. 12, figs. 1, 2, 3, has been considered an endodontid, a strobilopsid or a proserpinid snail by different authors. Berthelin, in Bull. Soc. Geol. France (3), XV, 1887, p. 61, found that there was complete removal of the internal partitions, and on that account he referred the genus to the Proserpinidæ.

Because of its blunt, expanded peristome I am inclined to view *Dimorphoptychia* as a member of the Helicinidæ, near the genera *Calybium* L. Morlet and *Heudeia* Crosse.

KANABOHELIX, new genus.

The shell is low trochiform, with rounded periphery and broadly expanded lip, within which there are four narrow folds (represented by linear grooves in the cast), subequally spaced, the lower one shortest, more prominent; a parietal tooth present(?). Type *Helix kanabensis,* pl. 12, figs. 4, 5, 6. Diam. about 12 mm.

KANABOHELIX KANABENSIS (White). *Helix kanabensis* WHITE, in Powell's Rep. on Geol. of the Eastern Portion of the Uinta Mountains, 1876, p. 120; Review non-marine fossil Mollusca of N. A., p. 48, pl. 25, figs. 12-14, in Ann. Rep. Director U. S. Geol. Surv. 1881-2 (1883). Cretaceous, Laramie: Point of Rocks Group, Upper Kanab, Utah. Figured on pl. 12, figs. 4, 5, 6.

In America no Tertiary or old fossils referable to *Strobilops* have been found. *Helix kanabensis* White was referred to

Strobila in this author's later paper (1883). The cast shows impressions of a series of baso-palatal teeth or short folds, and the general form is not inconsistent with the *Strobilops* group, but the folds are close to the lip within, and the shell is so much larger (diam. about 12 mm.), that the relationship claimed appears highly problematic. At present I am inclined to consider *K. kanabensis* an helicid snail.

Strobila leiodus Hutton, 1883. Trans. N. Z. Inst. XV, p. 135. Belongs to *Ptychodon* in Endodontidæ.

Strobila octoradiata Sars, 1835. Beskrivelser etc., p. 16. Belongs to the Acalephæ.

Helix sublabyrinthica Edwards, 1852 (Monogr. Eocene Moll., p. 69, pl. 11, f. 4), referred to *Strobilus* by Sandberger, 1873, and to *Strobilops* by Wenz, 1915, 1923, has been shown by L. R. Cox to belong to *Acanthinula* (Proc. Malac. Soc. London, XVII, 1926, p. 53, fig. 10). Upper Oligocene. Cox suggests that this species may prove identical with *Acanthinula paludinæformis* Sdbg.

Helix lautricensis Noulet, 1867, Bull. Soc. Hist. Nat. Toulouse, I, p. 151, has been considered a synonym of the preceding. It occurs in various localities in Dép. Tarn, France.

Helix (*Patula*) *recurrecta* Oppenheim, Denkschriften K. Akad. Wissensch., Wien, LXVII, 1890, p. 123, from the Vincentine Eocene, Altissimo, is possibly a *Strobilops,* but the aperture is filled up so that teeth, if present, would not show.

Genus STROBILOPS Pilsbry.

Strobila Morse, Terrestrial Pulmonifera of Maine, in Journ. Portland Soc. Nat. Hist., I, 1864, p. 26, for *Helix labyrinthica* Say. Not *Strobila* M. Sars, Beskrivelser og Iagttagelser over nogle maerkelige eller nye i Havet ved den Bergenske Kyst lebende Dyr, 1835, p. 16. Not *Strobila* Sodoffsky, Bull. Soc. Imp. Nat. Moscou, 1837, No. VI, pp. 92, 97, a name substituted for *Coccyx* of Ochsenheimer and Treitschke, Schmetterlinge von Europa, VII, 1829.

Strobilus Sandberger, Land- und Süsswasser-Conchyl. der Vorwelt, 1872-1875, pp. 258-726, and of many other authors. Not *Strobilus* Anton, Verzeichniss der Conchylien, etc., 1839, p. 46; see Man. Conch., XXIII, p. 188 (Tornatellinidæ).

Strobilops Pilsbry, Proc. A. N. S. Phila. for 1892, p. 403 (Feb. 7, 1893), a substitute for *Strobila* Morse; Nautilus, VI, 1892, p. 56; XXII, 1908, p. 78. — Hanna, Nautilus, XXV, 1922, p. 91 (anatomy).—Wenz, Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, 1915, II, pp. 63-88 (synopsis of Tertiary species); Nachrichtsblatt d. Deutschen Malakozoologischen Gesellschaft, 1916, pp. 178-192 (synopsis of Recent species).

The shell is small, perforate or umbilicate, trochiform to subdiscoidal, with rounded, angular, or carinate periphery, of 4½ to 6 closely-coiled whorls. Cavity of the last whorl is obstructed by two or three long parietal lamellæ, the upper one emerging to the edge of the parietal callus, the lower one weaker, emerging or immersed, the intermediate one when present, smallest and remote from the aperture; a series of two or more short folds on the basal wall of the cavity deep within the last whorl. These lamellæ and folds appear very early in life, grow at the forward end and are absorbed behind. Peristome expanded, usually thickened, the insertions of the lip remote, connected by a parietal callus.

The sole is short and broad, in movement showing two or three advancing muscular waves at one time; no pedal grooves. The integument has a network of impressed lines. Eyes are well-pigmented, on eye stalks a little swollen distally. Tentacles short but moderately well-developed (pl. 4, figs. 9, 11, *S. labyrinthica*).

Anatomy according to Hanna.—The kidney is long and narrow, passing anteriorly into the long urethra (*ur.*) which lies close to the intestine (*g*) and opens near the breathing pore (pl. 4, fig. 8). Genitalia (pl. 4, fig. 7, *S. labyrinthica*): Ovotestis (*ot*) composed of follicles in two groups, imbedded in the liver. The lower portion of the spermoviduct (*h. d.*) is thick and strongly convoluted. Albumen gland with finely granulose surface. The prostate forms a "series of lamellar pouches." Vas deferens is long, passing below into a rather thick and very long epiphallus (*ep.*). Penis (*p*) is rather stout in the lower half, abruptly becoming thin in the upper (or possibly this thin portion is part of the epiphallus; a question to be settled by opening the organ). It bears a very long

appendix (*ap*) which is thickened at the base and in the distal half. The penial retractor (*pr*) is bifurcate, one branch inserted at the summit of the penis (or on the epiphallus), the other on the swollen basal part of the appendix; posteriorly the retractor joins the right ocular muscle. The oviduct is "thin-walled, slightly pouched." The spermatheca (*sp*) on a duct of medium length without diverticulum.

The animal is oviparous.

The digestive tract is composed of the usual elements; buccal mass, salivary glands, œsophagus, stomach and intestine. Two features seem to be noteworthy. The œsophagus is not a slender duct as usual, but the walls are "knotty" or slightly convoluted throughout. Also on the stomach there appears to be an accessory gland, closely appressed to the walls of that organ. The salivary glands are united into one but they seem to discharge into the buccal mass at the usual two points.

Type, *S. labyrinthica* (Say).

Distribution: Humid eastern half of North America from Quebec, Ontario and Manitoba, N. Lat. 52°, to Guatemala; Cuba and Jamaica; South America from Venezuela, northeastern Brazil and the Galápagos Islands; Japan, Korea, China and the Philippines. Eocene to Pliocene of central and western Europe.

Strobilops comprises small snails living on decaying logs and dead leaves in moderately humid forest. The genus is not known in America west of the 100th meridian, but eastward its distribution is probably almost continuous, from James Bay in the north to Guatemala, although at present there are few Mexican records. It has not been turned up in Costa Rica or Panama, the best known Central American faunas, but appears again in Venezuela, Pará and the Galápagos. These three remote localities in South America may indicate a wide distribution in that continent, and perhaps many species to be discovered.

In eastern Asia species have been found in Uzen Province of northern Nippon, in Korea and China. The peculiar subgenus *Enteroplax* is confined to the Philippines.

In Europe about twenty species are known running from the Eocene to the Upper Pliocene.

The remarkable discontinuity in the distribution of *Strobilops,* and even of its subgenera, will be seen by the accompanying map upon which the occurrence of the genus is roughly indicated.

FIG. 2. — World in North Polar projection. Tertiary distribution of Strobilops represented by dots; Recent by black spots, and Discostrobilops by horizontal lines.

These small snails attracted attention more than a century ago, the first (Eocene and Oligocene) species having been described by Brongniart in 1810. Say discovered the first living species in 1817. The genus appears to have been a favorite one with paleontologists; notices of the species, especially in

Oligocene and Miocene beds, are very numerous. All of the early authors referred the species to *Helix*. E. S. Morse, 1864, was the first to demonstrate the intricate internal structure of the shell, and to recognize that it belongs to a special genus, which he named *Strobila*—a name which unfortunately proved to be a homonym. Sterki (Nautilus, VI, 1892, pp. 3, 6) removed the genus from the Helicidæ to the family Pupidæ (Pupillidæ). Hanna (1922) described and figured the anatomy, and proposed the name Strobilopsidæ. Several articles by the present writer (1893-1909) enlarged our knowledge of American forms, pointed out the occurrence of the genus in eastern Asia, and indicated the relationship of the Philippine forms of the subgenus *Enteroplax* to *Strobilops*. Finally, W. Wenz has reviewed the species in two excellent articles: "Die fossilen Arten der Gattung Strobilops Pilsbry und ihre Beziehungen zu den lebenden," 1915, and "Zur Kenntnis der Gattung Strobilops Pils.," 1916.

Of the twenty-eight Recent forms now known—nineteen species and nine subspecies—I have not seen specimens of the following four: *Strobilops veracruzensis crossei, S. salvini, S. diodontina* and *S. trochospira*. The type specimens of 13 species and 6 subspecies have been examined; the remaining three species are known to me by specimens from the original collectors.

Classification.

The first attempt to classify the species of *Strobilops* into natural groups was made by W. Wenz (1915, pp. 84-86). Considering the fossil species only, he proposed three groups.

1. Group of *S. diptyx*, for the species *diptyx, fischeri, boettgeri, subconoidea, duvali.* This line begins in mid-Oligocene time and runs to mid-Pliocene, in central and western Europe. Perhaps *S. elasmodonta* belongs here: it differs from all the others by possessing an interparietal lamella.

2. Group of *S. costata*, with the species *costata, joossi, tiarula, romani, labyrinthicula.* Probably *S. monilia* and *S. menardi*, and evidently *S. headonensis* and *S. pseudolabyrinthica* are to be added. This series ran from Eocene prob-

ably, and certainly from Lower Oligocene to mid-Pliocene times.

3. Group of *S. uniplicata,* for *S. uniplicata* and its subspecies. Upper Oligocene to Upper Miocene.

A few of the Tertiary species are not known fully enough to decide upon the group. Nearly all of the living species appear to be referable to one or other of Wenz's three groups, though the definitions given by him require some modification to provide for them, as would be expected.

The number and relative size of the basal folds can hardly be considered a subgeneric character, being rather variable among closely allied species. Probably forms with a columellar lamella and three basal folds, with none above the periphery, represent a rather primitive stage, this number being found in various Tertiary species as well as in the peripheral South American forms. At the same time, some early forms, such as *S. headonensis* and *sublabyrinthica* possessed more numerous basal folds and also some above the periphery (palatals), just as in the Recent *S. labyrinthica.* It appears that there has been some parallel evolution in these folds, and an increased number may appear in different phyletic lines, if the multilaminate forms are actually the later products of evolution.

The interparietal lamella may be either present or wanting in the group of *S. hubbardi,* but it is certainly absent in most of the finely striate species (group 1 of Wenz = *Eostrobilops*), and it is present in the costate ones (group 2 = typical *Strobilops*). Probably this lamella was present in the ancestral stock, but degenerated in some groups. Thus, it is developed in *S. uniplicata,* but very weak or usually absent in the modern *S. hubbardi.* The degree of minute sculpture of the edges of the parietal lamellæ varies rather widely; Wenz did not find prickly knots on the lamellæ of his group 2, but they are present, though inconspicuous, in the Pliocene *S. romani* (pl. 12, figs. 11, 12, 13), and are more or less conspicuously developed in all living species of the same group.

The following arrangement is here adopted:

Strobilops
- S.-g. Strobilops....
  - Sect. Strobilops *s. s.*
  - Sect. Eostrobilops.
- S.-g. Discostrobilops.
- S.-g. Enteroplax.

Key to Subdivisions of Strobilops.

1. Parietal callus having a thickened, raised edge, prominent where the parietal lamella joins it; parietal lamellæ with smooth or microscopically serrate edges, not nodiferous; shell thin, carinate. Philippines.
   Subgenus ENTEROPLAX, species Nos. 16-19.

   Parietal callus not noticeably thickened or raised at the edge. (2)
2. Form conoidal; umbilicus narrow; parietal lamellæ generally with prickly or rugose nodes. (3)

   Form subdiscoidal; umbilicus wide; parietal lamellæ with sparsely prickly or smoothish edges, not nodiferous.
   Subgenus DISCOSTROBILOPS (type *S. hubbardi*), species No. 15.
3. Upper surface finely striate; no interparietal lamella.
   Section EOSTROBILOPS (type *S. hirasei*), species Nos. 11-14.

   Upper surface costulate (except in *S. morsei,* which is nearly smooth); an interparietal lamella present.
   Section STROBILOPS proper, species Nos. 1-10.

The species are grouped geographically as follows:

Canada and the United States, species 1 to 4*b*, 15.
Mexico and Central America, species 4*c* to 7, 15.
West Indies, species 15.
South America, species 8 to 10.
Japan, Korea and China, species 11 to 14.
Philippine Islands, species 16 to 19.

Section STROBILOPS proper.

The shell is trochiform or dome-shaped with *the upper surface or the whole shell ribbed* (except in *S. morsei*). One or two parietal lamellæ emerge; deep within, their edges have rugose or prickly nodes (in the Recent species, at least); *an*

interparietal lamella is developed deep within. Internal barrier consisting of a columellar lamella, several basal folds and often other palatal folds above the periphery. Type, *S. labyrinthica.*

All living American species except *S. hubbardi* belong to this group. Also the European Tertiary *Gruppe der Strobilops costata* of Wenz (1915, p. 85). In the latter the knots of the lamellæ appear to be very weak or wanting; "von einer Zähnelung der Lamellen habe ich nichts bemerkt," Wenz observes; but in the Pliocene *S. romani* (Pl. 12, figs. 11, 12, 13) roughened nodes are present though inconspicuous.

There are two groups of species: first, that of *S. labyrinthica,* in which there are numerous basal folds and one or two above the periphery; this group including also *S. texasiana* and *S. affinis.* Second, the group of *S. strebeli,* in which there are three (or in *S. œnea,* four) basal folds and none above the periphery; the Mexican and South American species belong here. Both of these groups appear to be represented in the Tertiary fauna of Europe.

Species of Canada and the United States.

1. Trochiform or dome-shaped species, in which the height much exceeds half the diameter; umbilicus narrow or moderate, contained 6 to 12 times in the diameter. (2)
   Subdiscoidal species, the height about half of the diameter; umbilicus contained between 3 and 4 times in diameter. *S. hubbardi,* No. 15.
2. Spire convexly conic or dome-shaped; elevated; usually 5 or more basal and palatal folds. (3)
   Spire rather low conic, its outlines but slightly convex; less elevated; periphery angular; 3 or 4 basal folds, none above the periphery. *S. œnea,* No. 4.
3. Diam. 2.3–2.5 mm.; basal folds strongly unequal. (4)
   Diam. 2.75–2.9 mm.; basal folds short, subequal, disposed in a regular curve. *S. affinis,* No. 3.
4. Finely ribbed. *S. labyrinthica,* No. 1.
   Coarsely ribbed; southern. *S. texasiana,* No. 2.

1. STROBILOPS LABYRINTHICA (Say). Pl. 1, figs. 1-11.

The shell is narrowly umbilicate, the width of umbilicus contained about 11 (9 to 12) times in the diameter of the shell; very convexly conic or dome-shaped, the periphery obtusely subangular. Whorls 5½, convex, very slowly widening, the first 1½ smooth, pale, the rest chestnut-brown, sculptured with narrow obliquely radial ribs narrower than their intervals, passing over the periphery but weakening at the base, the first half of which is typically nearly smooth. The aperture is semi-lunar. Peristome brown, expanded, thick. The parietal lamella emerges to the edge of the parietal callus and penetrates inward a little more than half a whorl. The infraparietal lamella is much smaller, only shortly emerging, the end visible in a basal view; inside it penetrates as far as the parietal lamella. There is a low and slender interparietal lamella between these lamellæ deep within; all three are strongly nodose at the edge, the nodes armed with minute prickles directed towards the aperture (Pl. 1, fig. 11). Within the basal and outer walls, at the last third of the base, there is a low, rather blunt columellar lamella and a forwardly curving series of five (or six) unequal basopalatal folds; first and second folds are large and high, the second longer; two or three following folds are low and thin, the one immediately above the periphery usually longer, and there is sometimes another fold above it (Pl. 1, fig. 6, a topotype; also figs. 7, 9).

Height 1.7, diam. 2.3 mm. (Philadelphia).

Height 1.8, diam. 2.3 mm. (Philadelphia).

Maine and Quebec west to Manitoba, Minnesota, Kansas and Arkansas, south to Georgia and Alabama. Type locality, Philadelphia, Pa.

Helix labyrinthica SAY, Journ. Acad. N. S. Phila., I, 1817, p. 124.—*Strobila labyrinthica* Say, MORSE, Terrestrial Pulmonifera Maine, Journ. Portland Soc. N. H., I, p. 26, figs. 64-67, pl. 8, f. 68.—BINNEY, Terr. Moll., V, 1878, p. 259, text-figs. 149-152, pl. 17, f. 3; pl. 5, f. o (teeth).—STREBEL, Beitrag Mexikanischer Land- und Süsswasser-Conch., IV, 1880, p. 43, pl. 4, f. 6*a* (Ohio).—F. J. FORD, Naut. III, p. 106 (Sedgwick Co., Ks.). — SAMPSON, Naut. VII; p. 33 (Missouri). — PRIME,

Naut. VIII, p. 70 (Long Island, N. Y.).—Price, Naut. XIV, p. 76 (Kentucky).

Strobilops labyrinthica Pilsbry, Proc. A. N. S. Phila. 1892, p. 404; Naut. VII, p. 57.—Pleas, Naut. VII, p. 69 (Henry Co., Ind.).—Walker, Naut. VII, p. 126; XI, p. 122 (Michigan).—Nylander, Naut. VIII, p. 126; XIV, p. 103 (Aroostook Co., Me.).—Schick, Naut. VIII, p. 137 (Philadelphia).—Smith, Naut. XIII, p. 35 (Michigan).—Ferriss, Naut. XIV, p. 103 (Cove, Ark.).—Colton, Naut. XVII, p. 100 (Mt. Desert).—Van Hyning, Naut. XVII, p. 131 (Des Moines, Iowa).—Rhoads, Naut. XVIII, p. 65 (Delaware).—Blaney, Naut. XVIII, p. 46 (Sowards I., Me.).—Daniels, Naut. XIX, p. 63 (Pleistocene, New Harmony, Ind.).—Hinkley, Naut. XX, p. 35 (Ala., Miss.); XXXIII, p. 14 (Dubois, Ill.).—Wheat, Naut. XX, p. 101 (Cayuga L.).—Jackson, Naut. XXI, p. 144 (North Haven, Me.).—F. C. Baker, Naut. XXIV, p. 69 (Unionville, Conn.); XXV, p. 67 (St. Lawrence R. islands); XXVIII, p. 10 (Michigan); Mollusca Chicago Area, Chicago Acad. Sci. Bull. III, 1902, p. 225, f. 58-60 (jaw and teeth); Life of the Pleistocene, Univ. Illinois Bull. XVII, 1920, p. 388 (Aftonian Pleistocene to Recent).—Wheeler, Naut. XXV, p. 124 (Ala.); XXXI, p. 114 (Clark Co., Ark.).—Sterki, Naut. XXIX, p. 123 (Geneva, O.).—Vanatta, Naut. XXXIII, p. 97 (Maine).—Walker, Ill. Cat. Moll. Michigan, 1906, p. 505, figs. 116-118.—Dall, Alaska: Land and Fresh Water Mollusks, Harriman Alaska Exped. XIII, 1905, p. 27, f. 7-9 (Carberry, Manitoba; Moose Factory; James Bay).—Wenz, Nachrbl. D. M. Ges. 1916, p. 179.—Zetek, Trans. Illinois State Acad. Sci. XI, 1918, p. 170 (near Urbana, in woods).

Strobilops affinis Vanatta, Nautilus XXXIII, p. 97 (Sebago, Cumberland Co., Maine).

Strobilops floridanus Vanatta, Naut. XXX, p. 72; XXXIII, p. 68 (New Jersey).

Strobila labyrinthica var. *virgo* Pilsbry, Nautilus VI, p. 94, Dec. 1892 (Sebec Lake, Piscataquis Co., Me.).—*S. virgo* Sargent, Nautilus IX, p. 89 (Clearwater Lake, Wright Co., Minn.).—G. H. Clapp, Naut. XIV, p. 64 (Mt. Agamenticus, Me.).—Berry, Naut. XXIV, p. 63 (Windemere, Waldo Co., Me.).—? Wheeler, Naut. XXXI, p. 114 (Arkadelphia, Ark.).—Walker, Ill. Cat. Moll. Michigan, 1906, p. 506, fig. 120 (abundant in northern Michigan; southward in Oakland, Saginaw and Kalamazoo counties).—Sterki, Proc. Ohio State Acad. Sci. IV, pt. 8, 1907, p. 378 (New Philadelphia, O.; seems to prefer elevated and dry places, whereas *S. labyrinthica* prefers damp places).—Daniels, 27th Ann. Rep. Dept.

Geol. and Nat. Res. Indiana, 1902, p. 585 (near Cannelton, Perry Co.; New Harmony, Posey Co.; Princeton, Gibson Co.; Wyandotte, Crawford Co., and Lake Maxinkuckee, Marshall Co.; beneath logs and rubbish in ravines and moist places).

Many of the older references to *Helix* or *Strobila labyrinthica* have been omitted, as it is impossible to tell whether they refer to this species, *S. affinis* or *S. ænea*.

The back, eye-stalks and tentacles are blackish gray, darker streaks running from the collar to the eye-stalks; sides of the foot and the tail are clear whitish gray (Pl. 4, figs. 9, 11).

S. labyrinthica differs from *S. affinis* by the longer, more conspicuously unequal basal folds, the first (inner) two much larger than the others, and the series does not form an even curve as in *affinis;* the infraparietal lamella generally emerges more; the shell is smaller and generally less elevated, the spire with more strongly convex outlines. In *S. ænea* the whole shell, and especially the last whorl, is lower, the outlines of the spire are less convex; the basal folds are less numerous, and there are none above the periphery; the color is brighter and more transparent than in *S. labyrinthica*.

No locality was mentioned by Say, but his cotypes, four specimens, are labelled "Penna.; Hyde and Mason," and probably came from the immediate vicinity of Philadelphia, which place I have selected as type locality. One of these shells is drawn in Pl. 1, figs. 3, 4.

Its usual stations are "under loose bark of logs, in half-decayed wood, among dead leaves and in sod at bases of trees."

The umbilicus may be narrow, enlarging but little in the last whorl, or it may enlarge to double the former width in the last half-whorl. The infraparietal lamella emerges more or less conspicuously. The degree of angulation at the periphery varies somewhat, and the sculpture of the base is also variable, often nearly smooth in front of the aperture as in the type, but sometimes distinctly ribbed throughout (the ribs are represented somewhat too strong in Pl. 1, fig. 8). The parietal lamella in rare instances penetrates as much as three-

fourths of a whorl (var. *parietalis*). The number of basopalatal folds outside of the second one (the third from the columellar), varies from three to four in adult shells, and there may be either one or two of them above the periphery.

The color of the shell varies from dark to light brown, and albino shells occur (Neosho Co., Kansas) which are similar to *S. l. virgo* in color, but have a wider umbilicus and a less emerging infraparietal lamella than typical northern *virgo*.

In a young shell of 1.7 mm. diameter the internal barrier consists of a rudimentary columellar lamella, four long basal folds and one above the periphery. In some individuals the number of basal folds is increased in the late neanic stage. In one young Kansas specimen, nearly ready to form the lip, there are ten, including the columellar lamella (Pl. 1, fig. 10); but so large a number is very exceptional, and I have never seen a fully adult shell with more than a columellar, four basal and a palatal fold—six in all. The supernumerary folds are evidently absorbed at the inception of the adult stage.

Morse's figure of the spines on the parietal lamellæ of *S. labyrinthica* represents them as longer and stronger than in any of the many shells I have opened. I conclude that his figures of the internal structure are rather diagrammatic.

1*a*. *S. labyrinthica* form *virgo* Pils. Pl. 4, figs. 3, 4.

Shell whitish with a faint green or yellow tint (or pale brown), the lip and lamellæ white. Umbilicus small, contained 10 times in the diameter. The infraparietal lamella emerges somewhat more strongly than usual in *labyrinthica;* otherwise the lamellæ and folds are the same. Height 2, diam. 2.5 mm.

Maine to Minnesota and Iowa; reported also from Arkansas; described from Sebec Lake, Piscataquis Co., Maine.

The albino shells are found associated with pale brown specimens in the type locality, all agreeing in lamellæ and other characters except color. As a color-form it is recognizable, but I believe of very little significance racially. It appears to be chiefly a Canadian Zone form.

1*b*. *Strobilops labyrinthica* form *parietalis,* new form. Pl. 9, figs. 10, 11.

Similar to *S. labyrinthica* in the convexly conic, ribbed shell and weakly emerging infraparietal lamella, but the lamellæ penetrate more deeply, being *between two-thirds and three-fourths of a whorl long* (fig. 10). There is a blunt columellar lamella and four basal folds, four within the side wall (fig. 11, oblique view of baso-palatal folds). The whole base is ribbed in some examples, or smoothish, merely finely striate in others. Height 1.75, diam. 2.35 mm.

The type locality of this form is Ardsley, Montgomery Co., Pennsylvania (Bayard Long); but very similar examples are before me from Gray Bluff, Marion Co., Tennessee; Lookout Mountain, near Valley Head, and Blount Spring, Alabama (H. H. Smith); Talahassee, Florida (C. W. Johnson); and Catahoula Parish, Louisiana, 1.55 x 2.15 mm. (C. B. Moore).

Most of the southern specimens are rather small, but in a lot from Woodville, Ala. (H. E. Sargent), the largest measures 2 x 2.7 mm. While it approaches *S. texasiana* and *floridana* by the long parietal lamella, it differs by the decidedly less coarse ribbing. The status of this form is doubtful; the sporadic distribution, as now known, seems to indicate that it is not a subspecies. It is introduced here to induce further investigation.

2. Strobilops texasiana Pils. & Ferr. Pl. 2, figs. 5 to 11.

Shell moderately elevated with dome-shaped spire; light brown; umbilicus contained about 8 times in the diameter. Whorls 5½, the first 1½ smooth, pale-corneous, the rest regularly ribbed obliquely, the last whorl rounded peripherally or a trifle and obtusely subangular in front, the riblets passing over undiminished upon the base, which is as strongly sculptured as the upper surface (or sometimes smoothish just in front of the aperture). Aperture with slightly expanded, well thickened, whitish peristome and a strong parietal callus. Parietal lamella emerging to the edge of the callus, penetrating fully three-fourths of a whorl. Infraparietal lamella less emerging, being very shortly and weakly visible in a basal

view, penetrating about as deeply as the parietal. There is a quite short and very low interparietal lamella, situated near the inner ends of the others. A third of a whorl within there is a very short, low lamella on the axis and five baso-palatal folds: near the axis two large basal folds, the inner tongue-shaped, the outer one longer; outside of these there is a minute and low third fold, often wanting, leaving a space; the fourth and fifth folds long and low (fig. 8). Just above the periphery on the outer wall a very weak, low, long sixth fold may often be traced, but in fully adult shells the smaller folds are usually reduced in number (fig. 10), or even wanting (fig. 9); the full number described above being rare except in the late neanic stage.

Height 2, diam. 2.4 mm. Type.

Height 2, diam. 2.3 mm. Alexandria, La.

Texas: drift of the Guadalupe river about four miles above New Braunfels (type loc.; Pilsbry and Ferriss, 1903); Austin (Pilsbry); San Marcos (Pilsbry and Ferriss); New Braunfels (Ferriss, Pilsbry, and Singley); Guadalupe river bottom, Victoria county, and Lavaca river, Jackson county (J. D. Mitchell); Lee county (Singley); Calhoun county (E. W. Hubbard); Gainesville (J. B. Quintard); Colorado river near Travis, Bastrop Co. (Julia Gardner). A smaller form, diam. 2 mm., was taken in drift debris of the Hondo river about two miles north of Hondo, Medina county (Ferriss and Pilsbry).

Oklahoma: Limestone Gap and Wyandotte (Ferriss and Pilsbry); Fort Gibson (E. W. Hubbard); Pottawatomie Co. (J. B. Quintard).

Arkansas: Ashley and Calhoun counties (C. B. Moore).

Louisiana: Sycamore and Wilson landings, Morehouse Parish; Alexandria, Rapides Parish (C. B. Moore).

Strobilops labyrinthica texasiana Pilsbry and Ferriss, Proc. A. N. S. Phila. 1906, pp. 147, 557.—Wheeler, Nautilus XXXI, p. 114 (Arkadelphia, Ark.).—Strecker, Naut. XXII, p. 65 (McLennan Co., Tex.).

This form differs from the closely related *S. labyrinthica* by the stronger, more spaced ribs, continued over the base, and by the more deeply penetrating parietal lamella.

2*a*. *Strobilops texasiana floridana* (Pils.). Pl. 2, figs. 1-4.

The shell is conic with convex outlines, almost dome-shaped; the periphery only weakly angular, the base convex; rather solid; brown, the summit whitish-corneous. Umbilicus contained about 8 times in the diameter. Whorls 5½, the first two smooth, the rest sculptured with narrow, *rather widely separated* ribs (about 30 on the last whorl). These *ribs continue on the base,* which is radially ribbed. Aperture semilunar, the peristome thick, narrowly reflected, brown or whitish; parietal callus rather thick at the edge. Parietal lamella emerging to the edge of the callus, *penetrating inward fully a whorl* (Pl. 2, fig. 3). Infraparietal lamella scarcely emerging, penetrating as far inward as the parietal lamella. The inner half of this lamella and of the parietal is nodose, the nodes minutely asperate. Interparietal lamella very low, about a half-whorl long, nodose, penetrating as deeply as the parietal lamella. There is one small, short axial lamella and four basal folds, the outer one peripheral in position; a single palatal fold is generally developed. These folds form a curved, very obliquely radial series, the middle of which is about a half-whorl back of the aperture. The two inner basal folds are much stouter and higher than the others, the second from the axis (or third, counting the axial) being the longest and highest of the folds, and somewhat sinuous (Pl. 2, fig. 4).

Height 2, diam. 2.4 mm. (Miami).

Height 1.9, diam. 2.2 mm. (Orlando).

Florida: Miami, Dade Co., type locality (S. N. Rhoads, M. Hebard, Pilsbry). Throughout the State, from Sugarloaf, Boca Chica and No-name keys to Clay Co. on the St. Johns River and Jackson Co. on the Chipola.

Strobilops floridanus Pilsbry, Nautilus XXIII, Dec. 1909, p. 90. — Vanatta, Naut. XXVI, pp. 21, 33 (No-name Key, Sugarloaf Key).—Wenz, Nachrbl. D. M. Ges. 1916, p. 184.—Walker, Naut. XXXI, p. 56 (Palm Beach).—*S. labyrinthica* Rhoads, Naut. XIII, p. 45.—Johnson, Naut. XIII, p. 142.

This form differs from *S. labyrinthica* by its widely-spaced ribs and long parietal lamella. This is typically a full whorl long, or somewhat more, thus differing from *S. texasiana* in

which the lamella is a little short of one whorl long, as will be seen on comparing pl. 2, figs. 3 (*floridana*) and 5 (*texasiana*). However, on examining long series I find some examples of *floridana* in which the parietal lamella is not over three-fourths of a whorl long, so that the distinction between *floridana* and *texasiana* is not a complete one, though obvious in most examples. There are also shells which approach the long-lamellate *parietalis* form of *labyrinthica* rather closely, though the coarser ribbing of the base in *floridana* is generally a differential character.

It is sometimes quite elevated, as in the second measurement above, but the high examples occur in lots with lower specimens.

3. STROBILOPS AFFINIS Pilsbry. Pl. 3, figs. 1-5.

The shell is convexly conic with obtusely angular periphery; the base moderately convex, becoming rather strongly so in its last third; glossy, brown, with pale apex; narrowly umbilicate, the umbilicus contained about 7½ to 8 times in the diameter. There are 6 moderately convex whorls, increasing very slowly, the first two smooth, the rest sculptured with narrow, somewhat retractive ribs. The first half of the base is smooth, the ribs barely passing over the peripheral angle and reappearing within the umbilicus, but they continue weakly over the last half. The aperture is semilunar, oblique. Peristome is well expanded, thickened within, its face convex and fleshy-brown in color. Parietal callus moderately strong. The parietal lamella emerges to the edge of the callus and penetrates inward about two-thirds of a whorl. The infraparietal lamella is low and weak, deeply immersed, not visible in a front or basal view. Interparietal lamella short and very weak. A third of a whorl within there is an obliquely radial series of about 8 folds: a short low lamella on the columellar axis, followed by two folds larger and higher than the rest, and an oblique series running to the suture, composed of 4 to 7 short subequal folds (fig. 4).

Height 2.5, diam. 2.75 mm.

Massachusetts to Minnesota and Kansas, south to northern

New Jersey and west of the Alleghanies to northern Alabama and Oklahoma. Localities of specimens seen follow. Massachusetts: New Bedford (J. H. Thomson). New York: Syracuse, Pleistocene (Burnett Smith); Poughkeepsie (G. Van Ingen); Upper Red Hook, Duchess Co. (W. S. Teator, type loc.); Staten Island (E. W. Hubbard, T. Bland). New Jersey: White Pond, Warren Co. (Pilsbry). Ohio: Kent (G. W. Dean). Michigan: Pine Lake, Oakland Co. (B. Walker). Minnesota: Dallas Lake, Wright Co. (H. E. Sargent). Illinois: Athens (E. Hall).

Strobilops affinis Pilsbry, Nautilus VII, Sept. 1893, p. 57. —Walker, Illustr. Cat. Moll. Michigan, 1906, p. 507, f. 121 southern Michigan, not reported north of Saginaw-Grand valley). — Daniels, Nautilus XIX, p. 63 (Posey Co., Ind.).— Ferriss, Naut. XX, p. 17 (Oklahoma City). — Nylander, Naut. XXII, p. 143 (Aroostook Co., Me.). — Hanna, Naut. XXIII, p. 95 (Douglas Co., Kan.).—Sterki, Naut. XXV, p. 116 (Glenrose, Texas).—Hinkley, Naut. XXXIII, p. 14 (Dubois, Ill.).—Sterki, Prelim. Cat. Land- and Fresh-water Moll. of Ohio, Proc. Ohio State Acad. Sci. IV, 1907, p. 378 (Summit Co.). — Zetek, Trans. Illinois State Acad. Sci. XI, 1918, p. 170 (Urbana, Ill., under old logs). — Chadwick, Notes on Wisconsin Moll., Bull. Wisconsin Nat. Hist. Soc., IV, 1906, p. 75 (Lake bluffs south of Whitefish Bay; Menomonee valley; Cudahy; Mishicot, Manitowoc Co., under conifers).—Daniels, 27th Ann. Rep. Dept. Geol. and Nat. Resources of Indiana, 1902, p. 586 (near Lake James, Steuben Co.; Tippecanoe Lake, Kosciusko Co.; Mitchell, Lawrenceburg, Wyandotte and Huntingburg in southern Indiana). — G. H. Clapp, in litt.: Thayer, Kansas (Ferriss); Evanston, Ill. (Baker); Culver, Ind. (Daniels); Cowan, Tenn. and Stevenson, Ala. (H. H. Smith).—F. C. Baker, Life of the Pleistocene, Univ. Illinois, Bull. XVII, 1920, p. 388 (Sangemon Pleistocene to Recent).

This shell is somewhat larger than *S. labyrinthica,* thinner, with the infraparietal lamella more deeply immersed and the baso-palatal folds less unequal, all being rather short and forming a regular curve across the base and up the outer wall. The outlines of the spire are somewhat less convex than in *S. labyrinthica* but more convex than in *S. æneа.*

4. STROBILOPS ÆNEA Pilsbry. Pl. 3, figs. 6-12.

The shell is narrowly umbilicate, the width of umbilicus contained about 6½ times in the diameter of the shell, low-conic, with obtuse, rounded summit, the *periphery distinctly but bluntly angular.* The base is somewhat *flattened below the periphery,* elsewhere moderately convex. Whorls 5½, convex, slowly increasing, the first 1½ smooth, corneous, the rest dark brown with a red-gold gleam; sculptured with narrow riblets which are somewhat oblique, retractive, rather fine and close. The base is smoothish, marked with growth-striæ only, except on its last third, where the riblets of the upper surface continue over the base. The aperture is semilunar, low but wide. Outer and basal lips brown, well expanded, somewhat thickened, the columellar margin dilated. The parietal lamella emerges to the edge of the parietal callus, penetrating inward a half whorl. Infraparietal lamella weakly emerging. Midway between the lamellæ there is a very weak, low, deeply-placed interparietal lamella. These lamellæ are nodose far within, the nodes roughened, shortly prickly (Pl. 3, fig. 10; pl. 4, fig. 2). The internal barrier, situated one-third of a whorl from the aperture, is radial, but slightly oblique (fig. 12); it consists of a short, weak columellar fold and four basal folds, visible through the shell; the second and fourth folds from the axis are long, the first short, the third fold weak or sometimes wanting; there is no fold above the periphery.

Height 2, diam. 2.7 mm. Paratype.

Height 1.9, diam. 2.75 mm. Type, fig. 6.

Height 1.5, diam. 2.4 mm. Randolph Co., Ala.

Massachusetts to Michigan, Illinois and Arkansas, south to southern Florida and Louisiana. Type loc., Cazenovia, N. Y. Localities of specimens examined follow: Massachusetts: Mt. Holyoke (A. D. Brown). New York: Cazenovia (Henderson, Walker, Clapp and Pilsbry, 1905); Lanesville and Marbletown (Van Ingen). New Jersey: Burlington Co. Bayard Long). Pennsylvania: Philadelphia; Chester Co. (B. Long); Berks Co. (Pilsbry); York Furnace (W. Stone). Delaware: Delaware City and Dover (S. N. Rhoads). Maryland: Great

Falls (also on the Virginia side) (Pilsbry). Ohio: Kent (G. W. Dean); Garrettville (R. Walton). Illinois: Edwards Co. (C. S. Hodgson); Sheridan (Ferriss). Tennessee: Cade's Cove, Blount Co., 2000 ft. (Ferriss); Cumberland Plateau, South Pittsburgh and Dove (H. H. Smith). North Carolina: Tuskeegee Mts., Graham Co. (Ferriss). South Carolina: Manning (W. Stone); Columbia (J. B. Clark). Florida: Manhattan, Lake Co. (Pilsbry and Johnson); Imri, Hamilton Co. (E. B. Chope); Fort Lauderdale (C. T. Simpson); Gainesville (J. B. Clark). Alabama: many places throughout the northern half of the state (H. H. Smith, H. E. Sargent).

Strobilops labyrinthica strebeli Pfr., Pilsbry, Nautilus VII, Sept. 1893, p. 57; Proc. A. N. S. Phila. 1900, p. 133; 1902, p. 429 (North Carolina). — Ferriss, Naut. XIV, p. 56 (Cade's Cove, Tenn.). Not *Helix strebeli* Pfeiffer.—*Strobilops labyrinthica* (Say) Walker, Ill. Cat. Moll. Mich., 1906, p. 506, f. 119 (not the synonymy) (Michigan). — *Strobila labyrinthica* Dall, Proc. U. S. Nat. Mus. VIII, 1885, p. 262 (Archer, Fla.). —*Strobilops ænea* Pilsbry, Nautilus XL, Oct. 1926, p. 69.

This species is well characterized by being more depressed than others of its region, with a decidedly angular periphery, the base flattened just below the angle; by the fine, thin ribs, the dark color and the wider umbilicus; moreover, there is no internal fold above the periphery. It was recognized as distinct over thirty years ago, but at that time it was confused with the Mexican species *S. strebeli* Pfr., which differs by its far narrower umbilicus.

S. ænea is often found associated with *S. labyrinthica,* these two being the most abundant and widely distributed species of *Strobilops* in the states east of the Mississippi River. West of the Mississippi *S. ænea* has been found only in Arkansas and Louisiana. It is the common Strobilops of the Gulf coastal plain.

4*a*. *Strobilops ænea* form *micromphala,* new form. Pl. 9, figs. 8, 9.

Lighter colored than *S. ænea,* between cinnamon and cinnamon-brown; outlines of spire more convex; umbilicus nar-

rower, contained about 8 times in the diameter; last third of base ribbed. The infraparietal lamella does not emerge. Three folds visible through the base. Height 1.7, diam. 2.5 mm.; 5½ whorls.

Arkansas: Menard Landing, Arkansas Co., Ouachita Co. (C. B. Moore). Louisiana: localities in Morehouse, Richland, Franklin, Catahoula and Rapides parishes (C. B. Moore); Grand Cane (Williamson) and Frierson (L. S. Frierson), De Soto Parish; type loc. Boeuf River above Charlieville, Richland Parish. Mississippi: Yazoo and Jackson counties (C. B. Moore). Alabama: Wetumpka (H. H. Smith); Simpson Island, Mobile River, Baldwin Co. (C. B. Moore). Washington, D. C. (E. Lehnert). New Jersey: Barton Run, Burlington Co. (Bayard Long). Pennsylvania: Tulpehocken Valley, near Germantown (B. Long).

This form occurs in the lower Mississippi Valley further southwest than the typical form of the species has been found. By its small umbilicus it approaches the Mexican *S. strebeli,* in which the ribs are more slender. I considered it a southwestern race of *S. œnea* until lots from Washington, D. C., Pennsylvania and New Jersey turned up, in which the umbilicus is almost as small as in Louisiana specimens—being contained 7½ times in the diameter. Further collections are required to fix the status of this form, which appears quite distinguishable in the series now available.

4*b*. *Strobilops œnea spiralis,* new subspecies. Pl. 9, figs. 5, 6, 7.

The shell is somewhat less depressed than *S. œnea,* light brown; ribs rather distinct on the base. *The parietal lamella is much longer,* forming a full whorl in the type (but slightly shorter, over three-fourths of a whorl, in specimens from Wyandotte, Indiana). The *basal barrier is situated more deeply* than in *œnea,* and consists, as in that species, of four basal folds and a small, short one on the columella.

Height 1.9, diam. 2.6 mm. Type.

Height 2.0, diam. 2.6 mm. Paratype.

North side of the summit of Magazine Mountain, Logan Co., Arkansas (type loc.; Ferriss and Pilsbry, 1903). Wyandotte,

Indiana (L. E. Daniels, 1905). Roanoke, Randolph Co., and Lookout Mountain near Valley Head, Alabama (H. H. Smith).

Species of Mexico and Central America.

All of the Mexican species except *S. hubbardi* belong to the group of *S. strebeli,* in which there is a small columellar lamella and *three basal folds; no folds above the periphery,* such as occur in the *labyrinthica* group. This Mexican group includes also the northern *S. œnea* and all of the South American species now known, except perhaps *S. helleri.*

In *S. veracruzensis crossei* the internal barrier has not been examined; probably it conforms in this respect to other conic Neotropic species. In *S. œnea* there are usually four basal folds, a minute one appearing between the second and third larger folds.

Key to Species.

1. Form subdiscoidal, the height about half the diameter; umbilicus contained 3 to 4 times in diameter. *S. hubbardi,* No. 15.

   Form low-conic (2).

   Form elevated, trochiform, the height 80 to 90 per cent of the diameter (3).

2. Umbilicus contained 5 to 5½ times in diam. *S. œnea mexicana,* No. 4c.

   Umbilicus contained 10 to 12 times in diameter. *S. strebeli,* No. 5.

3. Umbilicus large, contained 3 to 4 times in diameter; shell carinate, diam. 3 mm. *S. salvini,* No. 7.

   Umbilicus small, about 10 times in diameter; shell smaller, subangular, with rather widely spaced ribs (4).

4. Diameter about 2 mm. *S. veracruzensis,* No. 6.

   Diameter 2.5 to 2.8 mm. *S. v. crossei,* No. 6a.

4c. *Strobilops œnea mexicana* new subsp. Pl. 5, figs. 9-13.

Umbilicus contained 5 to 5½ times in the diameter, thus far larger than in *S. strebeli,* and somewhat larger than in *S. œnea.* There are three basal folds, a short one and two

long, as in *S. strebeli.* The color of shell and lip is cinnamon in the type lot, all dead shells, but chestnut brown in the fresh shells from Necaxa. The glossy base is largely smoothish, the last third ribbed more or less.

Height 1.8, diam. 2.7 mm.; 5½ whorls. Type.

Height 1.95, diam. 2.75 mm.; 5½ whorls. Necaxa.

Height 1.8, diam. 2.6 mm. Necaxa.

Eastern and northeastern Mexico: Diente, near Monterey, Nuevo Leon (type loc.; S. N. Rhoads, 1899). Around Necaxa, northern Puebla (H. Burrington Baker, 1926).

This form appears to be abundant in both of the localities known, which are in a higher zone than that inhabited by *S. strebeli.* I have separated it from *S. œnea* with some doubt, as the difference is slight, but the umbilicus in *œnea* seems always to be a little smaller, the color of fresh shells is different, and adult individuals of *œnea* from the United States generally have four basal folds.

5. Strobilops strebeli (Pfr.). Pl. 5, figs. 1-4.

"Shell perforate, depressed-conoid, closely costulate above, brown; spire convexly conoidal. Whorls 5½, a little convex, slowly increasing, the last not descending, with a crenulate, subcarinate periphery, nearly smooth below the angle. Aperture oblique, ear-shaped, furnished with two parietal lamellæ (the outer one reaching forward, the other more deeply placed); peristome simple, the upper margin straight, the basal a little reflected towards the insertion. Greater diam. 2⅔, lesser 2½, height 1½ mm." (*Pfr.*).

Helix strebeli Pfeiffer, Malak. Blätter VIII, 1862, p. 71, pl. 1, f. 5-8; Monographia Hel. Viv. V, p. 222.—*Strobila labyrinthica* Say (specimens from Mirador), Strebel, Beitrag Mex. Land- und Süsswasser-Conch. IV, 1880, p. 43, pl. 4, f. 6 (only); pl. 15 fig. 7 ?.—Von Martens, Biologia Centr. Amer., Moll., 1892, p. 173.

Mirador specimens, which are doubtless part of the original lot, are drawn in pl. 5, figs. 1 to 4. They agree fully with three examples, 14554 Strebel collection, coll. by Berendt, kindly lent by the Zoologische Staatsinstitut und Zoologische Museum, Hamburg. Two of these measure:

Height 1.65, diam. 2.5 mm. Umbilicus slightly more than 11 times in diameter.

Height 1.6, diam. 2.4 mm. Umbilicus 11 times in diameter.

Strebel's figures are reproduced in pl. 4, fig. 5. Pfeiffer's description and figures appear to have been from a specimen scarcely mature. The small umbilicus is contained about 11 to 12 times in the diameter. The rather strong ribs pass over the very bluntly subangular periphery, but then gradually disappear, leaving the greater part of the base merely striate; but under a high power, some specimens show faint traces of fine, close, weak spiral striæ. The shell is rather strong, opaque and cinnamon-brown, the slightly expanded and thickened lip of the same color. There is a slight spiral groove in the latter part of the last whorl, just outside of the umbilical suture. The white parietal lamella is high near its anterior termination, penetrates inward exactly half of a whorl; towards the inner end its edge shows strong nodes which are roughened by microscopic, rather blunt asperities. The infraparietal lamella is visible in a basal view but does not emerge to the edge of the parietal callus; it penetrates as far inward as the parietal; between them, near the inner ends, is a very low, nodose interparietal lamella. There is a low columellar lamella and three basal folds, that near the axis short. (In one specimen, pl. 5, fig. 2, there seems to be two short and two longer folds, seen faintly through the base, but the indications of folds are so weak in this shell that the appearance drawn is not trustworthy; its visibility was exaggerated by the draughtsman).

Height 1.8, diam. 2.6 mm.; 5¼ whorls.

Height 1.8, diam. 2.4 mm.; 5 whorls.

5*a*. *Strobilops strebeli guatemalensis* Hinkley. Pl. 5, figs. 5, 6, 7, 8.

The shell is more sharply angular at the periphery than *S. strebeli,* with a somewhat smoother base, microscopically striate spirally, and a less thickened lip. The width of the umbilicus is contained about 10 times in the diameter of the shell. There are three basal folds.

Height 1.55, diam. 2.4 mm.; 5 whorls. Paratype.

Height 1.5, diam. 2.2 mm.; 4¾ whorls. Type.

Guatemala: near Jocolo, in beach debris of Lake Izabal (A. A. Hinkley).

Strobilops strebeli guatemalensis Hinkley, Nautilus, vol. 34, Oct., 1920, p. 52.

There is an obvious error in the measurement of width as printed in Hinkley's description. The type is figured.

6. Strobilops veracruzensis, new species. Pl. 4, fig. 6; pl. 9, figs. 1, 2, 3.

The shell is pyramidal, the spire with weakly convex outlines, periphery bluntly subangular, base moderately convex. Umbilicus narrow, its width contained about 10 times in the diameter of the shell. Surface slightly glossy, the initial 1½ whorls smooth, next whorl with some fine striation, after which there are narrow, oblique ribs, widely and unevenly spaced, passing over the periphery but then disappearing except around the margin of the umbilicus and behind the lip, leaving the greater part of the base smooth. The whorls are moderately convex. The aperture is oblique; peristome blunt, expanded, thickened within, dull orange-cinnamon, the parietal callus rather thin. The parietal lamella penetrates inward about two-thirds of a whorl, its edge inwardly having numerous low nodes. The infraparietal lamella emerges, but not to the edge of the callus, and inwardly it is shorter, length about half a whorl, and more conspicuously nodose than the parietal, the nodes rugose. Between the inner ends of these lamellæ there is a short, low interparietal lamella, consisting of a series of about half a dozen rugose tubercles strung together. Nearly a half-whorl inward there is a small blunt columellar lamella, a larger inner basal fold, followed by a much larger, high and long basal, and at some distance peripherad a long, rather low and laminar third basal fold (Pl. 9, fig. 2).

Height 1.9, diam. 2.1 mm.; 5½ whorls.

Mexico: neighborhood of Vera Cruz (H. Strebel).

Strobila labyrinthica (Umgegend von Vera Cruz), Strebel,

Beitrag Fauna Mex. Land- und Süsswasser-Conchyl., IV, 1880, p. 44, pl. 4, fig. 6*b*. Not *H. labyrinthica* Say.

This species stands close to *S. braziliana* of Pará. It is smaller, with the spire more straightly conic. By the high contour and widely-spaced ribs it differs from other Mexican species.

Strebel had two specimens of this species, both figured by him, the figures copied photographically on my Pl. 4, fig. 6, and both are drawn in Pl. 9, figs. 1-3. These specimens are No. 14581 of the Strebel collection in the Zoologisches Institut und Zoologisches Museum, Hamburg.

Strebel suspected that this form might be worthy of varietal separation from *S. labyrinthica,* in which species he included *S. strebeli,* but it certainly differs widely from both. No comparative study of the different Strobilops forms had been made at the time he wrote. *S. veracruzensis* belongs to the *strebeli* group, by the arrangement of internal folds, but it differs strongly by the high contour and the widely-spaced ribs.

6*a*. *Strobilops veracruzensis crossei,* n. subsp. Pl. 9, figs. 4, 4*a*.

The shell is narrowly umbilicate, conoidal, quite thin, with well-spaced, slightly oblique riblets; pale brown. Spire convexly conic, the apex rather obtuse; suture impressed. Whorls 5½, very weakly convex and slowly increasing, the last whorl not descending, obtusely subcarinate peripherally, and becoming nearly smooth below the carina and over all the basal surface. The aperture is oblique, auriform, colored like the rest of the shell, provided with and narrowed by two slightly diverging parietal lamellæ, of which the first is noticeably stronger and more projecting, while the other, nearer the columella, is less developed. Peristome simple, the margins united by a thin callous deposit, columellar margin slightly reflected, the basal and outer margins weakly thickened, upper margin straight. Height 2.25, greater diameter 2.5, lesser 2.25 mm. (*Fischer* and *Crosse*).

Mexico: Plantation "Mirador," near Soledad, in the State of Vera Cruz (Dr. Berendt).

Helix strebeli Fischer and Crosse, Miss. Sci. au Mexique,

Moll. terr. et Fluv., I, 1872, p. 267, pl. 12, f. 7*a-b*. Not *H. strebeli* Pfeiffer.—*Strobila labyrinthica* (in einer hochgewundenen Form), STREBEL, Beitrag etc., IV, 1880, p. 44.

This is a form which I have not seen, but, since it has been figured by Fischer and Crosse, I introduce it here in order to complete the account of Mexican *Strobilops*. It appears to differ from *S. veracruzensis* by the larger size and the more prominent infraparietal lamella, if we may trust the figure, which is possibly somewhat diagrammatic. Fischer and Crosse state that it differs from *labyrinthica* by the spaced instead of close riblets, also they emphasize the perfect visibility of two parietal lamellæ, the infraparietal emerging more prominently than in *labyrinthica*. Their criticism of Pfeiffer's figures of *strebeli* was due to the fact that they did not have that species before them, but a much more highly conic form.

Strebel stated that he had the Mirador plantation *Strobila* in "a depressed and a high-coiled form, which last resembles the North American form. Transitions are not present." He gave the dimensions: height 2.4, greater diam. 2.8, lesser 2.6 mm.; 6 whorls.

7. STROBILOPS SALVINI (Tristram). Pl. 4, fig. 1.

Shell deeply umbilicate, conic, trochiform, rufous-corneous, acutely carinate; spire conic, the summit glossy; suture deep; whorls 7, a little convex, regularly increasing, regularly ornamented above with transverse, acute and very conspicuous but not continuous liræ; the last whorl delicately striate beneath, peristome somewhat reddish, polished, reflected; aperture semilunar. Diam. maj. 3, min. scarcely 3, height 2½ mm. (*Tristram*).

Shell rather widely umbilicate, trochiform, angular, tawny, obliquely ribbed above, smoothish below, showing by translucence three spiral laminæ. Spire conic, of 5½ slightly convex whorls. Aperture rather oblique, lunar, the peristome thickened, shortly reflected, the parietal wall provided with an entering fold. Greater diam. 3, lesser 2½, height 1½ to 2 mm. (*v. Martens*).

Northern Guatemala: mountain forests of Vera Paz (Salvin).

Helix salvini TRISTRAM, Proc. Zool. Soc. London, 1863, p. 411. — PFEIFFER, Monogr. V, p. 334. — *Strobila salvini* VON MARTENS, Biol. Centr.-Amer., Moll., p. 174, pl. 10, f. 1-1*c*.

I have not seen this species, which appears to be more elevated and more distinctly angular than *S. strebeli,* with a wider umbilicus than any North American species of its group. The measurements given by von Martens from the type do not agree well with his figures, and are given differently in his table (Biologia, p. 173), perhaps partly transposed with those of *S. labyrinthica.* According to his figure, the umbilicus is contained about 3.7 times in the diameter. Von Martens writes as follows:

"An inspection of the typical specimens, kindly lent me by Canon H. B. Tristram, enables me to give a fuller description of this species, which proves to be nearly allied to *S. labyrinthica* (Say). The riblets of the upper surface cross the angle of the periphery and extend a little way on the lower face of the shell. The umbilicus occupies about one-third of the diameter of the shell, whereas in *S. labyrinthica* it occupies only about one-fifth of it.

"The internal lamellæ are in this species about the same as in *S. labyrinthica,* according to the description given by E. Morse and the figures contained in Binney's works. Two whitish spiral lamellæ are visible from outside at the base, shining through the shell, more distinctly in young shells than in full-grown ones, because in those the shell is thinner; they are situated really on the upper side of the lower wall of the last whorl. Two others, situated on the lower side of the upper wall or ceiling (parietal lamellæ), are to be seen by looking into the aperture of a not full-grown shell; the uppermost, or that nearest the suture, is the longest, extending even somewhat beyond the limit of the aperture in the observed specimen, the following one is shorter and lies more beneath—it corresponds to the third of *S. labyrinthica* in the above-mentioned figures. A corresponding lamella to the second of *S. labyrinthica* is not visible in the specimens of *S. salvini,* probably only because it does not come so near to the aperture, and I would not break the only shell which exhibited

clearly those lamellæ by seeking it. Under an ordinary lens these lamellæ show also in *S. salvini* the repeated swellings described by Morse. In fragments of *S. labyrinthica* from Florida, examined for comparison by myself and Dr. Hilgendorf, under a higher magnifying power, the swellings appear to be somewhat less regular, and composed of more scattered and shorter points than in the said figures."

South American Species.

Strobilops morsei and *S. braziliana* appear to be closely related to species of Central America and Mexico, with which they agree in internal armature.

By its smooth surface *S. morsei* is unique, but some specimens show very weak traces of ribs, showing descent from a ribbed ancestral stock.

S. helleri is a very distinct species, possibly forming a separate subgenus, but I have not opened the single specimen found; its internal structure is not known.

Key to South American Species.

1. Shell elevated, trochiform, of 5½ to 6 whorls, the last with angular periphery and weakly convex base; umbilicus narrow, contained 11 to 13 times in the diameter; diameter about 2.5 mm. (2)

   Shell rather low, of 4½ whorls, with dome-shaped spire, carinate periphery and strongly convex base; umbilicus large, contained about 4 times in the diameter; diameter about 3 mm. Galapagos Islands. *S. helleri,* No. 10.

2. Surface nearly smooth. Venezuela. *S. morsei,* No. 8.

   Surface strongly ribbed. Brazil. *S. brasiliana,* No. 9.

8. Strobilops morsei (Dall). Pl. 6, figs. 4, 5, 6.

The shell is trochiform with nearly straight lateral outlines, obtuse apex, strongly angular periphery and weakly convex base, perforated by a very small umbilicus, contained between 12 and 13 times in the diameter. The whorls are weakly convex. Dead but rather fresh specimens are cinnamon-colored without much gloss; *nearly smooth,* but there are

some low growth-wrinkles, and in a few places the faintest traces of a few ribs may be recognized. The base is smooth except for some obliquely radial wrinkles in the umbilical region. The peristome is slightly expanded and moderately thickened. The parietal lamella emerges to the edge of the parietal callus, the infraparietal nearly to the edge. There is a short columellar lamella immersed about one-third of a whorl, and three basal folds, the inner one short, the others rather long; the middle fold is arcuate, the outer one straightened (fig. 5).

Height 2.3, diam. 2.5 mm.; 6 whorls. Type.

Venezuela: Puerto Cabello (Sumichrast).

[*Strobila labyrinthica*] var. *Morsei*, and *S. Morsei* DALL, Proc. U. S. Nat. Mus. VIII, 1885, p. 263.

This species is well distinguished by its almost smooth upper surface, the strongly angular periphery and the long emergence of the infraparietal lamella. The basal plicæ are similar to those of the *S. strebeli* group. Figs. 4, 6 represent the type specimen, 24013 U. S. N. M.; fig. 5 is from one of the shells collected by Ralph Tate, No. 22923 collection of the Academy. The faint ribs traceable on some specimens are apparently indicative of a costate ancestral stock.

9. STROBILOPS BRASILIANA F. Baker. Pl. 6, figs. 7, 8, 9, 10, 11.

The shell is trochiform with somewhat convex lateral outlines, obtuse apex, angular periphery and weakly convex base; the very small umbilicus contained between 11 and 12 times in the diameter. The whorls are weakly convex. Cinnamon-brown, the surface without much gloss, last three whorls sculptured with *widely, unequally-spaced* narrow ribs, the base smoothish but with obliquely radial wrinkles in the umbilical region. The lip, colored like the shell, is somewhat expanded and moderately thickened. The parietal lamella emerges to the edge of the parietal callus, the infraparietal nearly to the edge; both penetrate about a half-whorl. Between their inner ends there is a weak trace of an interparietal lamella. All have nodose edges, the nodes bearing blunt, forwardly-directed tubercles (fig. 11, edge of parietal lamella). There is

a short columellar lamella and three basal folds (fig. 8), the inner fold short, the second long, arcuate, the third long and straightened.

Height 2.3, diam. 2.6 mm.; 5¾ whorls. Type.

Height 2.1, diam. 2.55 mm. Paratype.

Brazil: Pará, under the bark of a decaying tree in the dense forest surrounding the water works of the city (Fred Baker).

Strobilops brasiliana Fred Baker, Proc. A. N. S. Phila., 1913, p. 647, pl. 21, f. 8, 9 (Jan. 28, 1914).

This species stands near *S. morsei,* differing by the well-developed ribs and the more convex lateral outlines of the spire. The ribbing is represented as nearly regular in the original figure and in our fig. 9; but it is noticeably irregular in *all* of the eight specimens found, which are now No. 109310 of this collection.

10. Strobilops helleri (Dall). Pl. 6, figs. 1, 2, 3.

The shell is solid, much wider than high, dome-shaped above, with obtuse apex, convex beneath, with an acutely carinate median periphery and a widely-open umbilicus contained about four times in the diameter. The whorls are convex, with a concavity just above the keel. Cinnamon-colored, with little gloss; first 1½ whorls smooth, after which they are finely, sharply costulate, the riblets becoming coarser and more spaced on the last whorl, weak on the projecting keel, rather close and somewhat irregular on the base (fig. 1). The lip is expanded, thickened, a little angular at the outer extremity, reflected at the columellar insertion. Parietal callus heavy. The parietal lamella is rather low, enlarging near its end, which does not quite reach the edge of the parietal callus. Very deep in the throat a low, infraparietal lamella can be seen in an oblique view in the mouth. At the last third of the base two basal folds can be seen by transparence through the base.

Height 1.9, diam. 3.1 mm., umbilicus 0.8 mm.; 4½ whorls.

Galápagos Islands: near Iguana Cove, Albemarle Island, at 2000 ft. elevation (Snodgrass and Heller).

Endodonta helleri DALL, Proc. A. N. S. Phila., 1900, p. 94, pl. 8, figs. 7, 8, 9.

The low contour, the acute, margined keel, the wide umbilicus and deeply immersed infraparietal lamella, as well as the small number of whorls, strongly characterize this species. It appears to be most like the Central American *S. salvini,* which however has more numerous whorls.

As *S. helleri* is known by only one specimen (no. 108515 U. S. N. M.), I have not examined the interior. Only two basal plicæ are visible through the shell, which is rather thick; probably there are three, in addition to a columellar lamella. The last two whorls are somewhat more convex above than the draughtsman has represented them in fig. 3.

Section EOSTROBILOPS, n. sect.

Gruppe der Strobilops diptyx WENZ, Neues Jahrb. Min., Geol. u. Pal., 1915, II, p. 84.

The shell is convexly conic, *finely striate,* with a rather small umbilicus. The parietal and infraparietal lamellæ emerge, and deep within their edges have prickly or rugose knots or nodes (and in recent species *flare outward*); *there is no interparietal lamella.* Internal barrier consisting of a low columellar and two to four basal folds, sometimes also a palatal fold. Type *S. hirasei.*

All known species of Japan, Korea and China belong to this group. Some of the European Tertiary species are more depressed than Recent forms.

Key to Species of Japan, Korea and China.

1. Larger species, diam. 3 to 3.5 mm.; umbilicus contained about 5½ to 7½ times in diameter of the shell (2).
   Smaller species, diam. 2.5 to 2.7 mm. (3).
2. Internal barrier consisting of a columellar, 3 or 4 basal folds and one above the periphery. Japan.
   S. nipponica, No. 14.
   Barrier consisting of a columellar and two basal folds. Quelpart Island. *S. hirasei,* No. 13.
3. Umbilicus small, contained about 9 times in the diameter;

internal barrier consisting of a columellar, 3 basal folds and one above periphery. Korea. *S. coreana,* No. 12.

Umbilicus larger, contained about 5½ times in the diameter; internal structure unknown. China. *S. diodontina,* No. 11.

11. STROBILOPS DIODONTINA (Heude). Pl. 10, figs. 1, 2, 3.

Shell very small, moderately umbilicate; fulvous, with a silky gleam; trochoidal, spire conic; whorls 5, cylindric, the last indistinctly depressed-angular, convex below; with an epidermis provided with thick spiral striæ and folds. Aperture oblique, semilunar, obstructed by two parietal lamellæ; peristome expanded, reflected, umbilicus wide, penetrating. Height 1.5, diam. maj. 2.5, min. 2 mm. (*Heude*).

China: Tchen-k'eou (Heude).

Helix diodontina HEUDE, Notes sur les Moll. terr. de la vallée du Fleuve Bleu, in Mem. concernant l'Hist. Nat. de l'Empire Chinois, 1880, p. 112, pl. 29, f. 11.

This species is known only from Heude's incomplete account. His figures are reproduced. It appears to be similar in size and shape to *S. coreana,* but from the description and figures it should have a larger umbilicus, contained about 5½ times in the diameter of the shell. That of the Korean species is much smaller. *S. diodontina* differs from *S. hirasei* by its smaller size.

12. STROBILOPS COREANA Pilsbry, n. sp. Pl. 10, figs. 8, 9, 10.

The shell is rather depressed with dome-shaped spire, rounded periphery (very weakly subangular in front) and convex base; umbilicus small, contained 9 times in the diameter. Cinnamon-brown, rather glossy, with weak, rather fine growth-wrinkles above, weaker on the base. The whorls are rather strongly convex. The aperture is lunate, lip expanded, heavily thickened within, russet. The parietal lamella is somewhat higher than the infraparietal, both emerging to the edge of the parietal callus; they penetrate about one-fourth of a whorl, then diminish to a low thread which continues some distance further. They flare outward and are strongly nodose

at the free edges. Nearly a fourth of a whorl behind the aperture there is an internal barrier composed of a short, blunt columellar lamella, a series of three basal folds (the second one longest, the others short), and a small fold within the outer wall above the periphery. Some of these folds are visible in an oblique view in the aperture.

Height 1.85, diam. 2.7 mm.; barely 5 whorls.

Korea: Pyong-Yang, in the northwestern part of the peninsula (T. Kuroda).

Strobilops coreana Pilsbry, Proc. A. N. S. Phila., vol. 78, p. 470, name only.

This is a smaller shell than *S. hirasei,* with smaller umbilicus, fewer whorls and four baso-palatal folds; differing further by the infraparietal lamella, which emerges further than in *S. hirasei,* about as far as the parietal lamella. The internal armature of this species is practically identical with that of *S. nipponica,* which is a larger shell with relatively larger umbilicus.

The relation of *S. coreana* to *S. diodontina* must be considered when specimens of that species become available. I do not understand Heude's description of the sculpture of *diodontina* — *"epidermide striis plicisque crassis spiralibus donato"*—terms which could not be applied to the very weakly obliquely striate Korean species. *S. diodontina* is said to be about the size of *S. coreana,* with five whorls and two emerging parietal lamellæ, but the umbilicus is described as moderate or wide, and figured as contained about 5½ times in the diameter, thus differing from *S. coreana.*

13. Strobilops hirasei Pilsbry. Pl. 10, figs. 4, 5, 6, 7.

The shell is rather depressed, with dome-shaped spire, the periphery mainly rounded but indistinctly subangular in front of the aperture, the base rather strongly convex; umbilicus small, widened in the last half-whorl, contained about 5½ times in the diameter of shell (in some examples smaller, 6 times or 7½ times in diameter). Opaque, cinnamon-brown, without much gloss, smoothish, with low growth-wrinkles. Whorls are strongly convex and increase slowly. The aper-

ture is oblique and lunate, peristome russet, expanded and well thickened; parietal callus moderately heavy. The parietal lamella is rather strong and emerges to the edge of the callus. The infraparietal lamella is relatively strong though much lower than the parietal, and emerges nearly to the edge of the parietal callus. Both lamellæ penetrate inward about one-third of a whorl, being conspicuously nodose at the edges, and there is a very weak continuation to about half a whorl inward. At a point about one-fourth of a whorl inward there is a low, short and blunt columellar lamella and two short basal folds. All or part of these are visible in an oblique view in the aperture, but owing to the opaque texture of the shell they are not visible through the base in specimens examined.

Height 2.2, diam. 3.2 mm.; 5½ whorls. Type.

Height 2.1, diam. 3 mm.; 5⅓ whorls.

Korea: Cheju, Quelpart Island (T. Kuroda).

Strobilops hirasei Pilsbry, The Conchological Magazine, II, No. 8, August, 1908, p. 39, fig. 1; Nautilus, XXII, p. 79.

This relatively large, solid *Strobilops* is distinguished from the preceding and the following species by the number of internal basal plicæ (two). It is somewhat larger than *S. diodontina,* in which the internal armature is unknown.

The growth wrinkles or striæ are rather fine and somewhat sharp below the suture, but are not regular in development in the peripheral and basal parts.

14. Strobilops nipponica Pilsbry, n. sp. Pl. 10, figs. 11, 12, 13, 14.

The shell is depressed, with low dome-shaped spire, rounded periphery (very obtusely subangular in front of the aperture) and convex base, the rather wide umbilicus contained about 5½ times in the diameter; rather thin, the base somewhat translucent. Cinnamon-colored, rather glossy, finely and lightly striate, the striæ stronger below the suture. The aperture is lunate, lip russet, slightly expanded, rather wide at basal and columellar margins but less thickened than in the Korean species. The parietal lamella emerges to the lip edge, is high and flares outward. Infraparietal lamella is lower and

does not quite attain the edge. Both penetrate one-third of a whorl and have strongly nodose edges (fig. 14). About one-fourth of a whorl behind the aperture there is a barrier composed of a short acute columellar lamella, three basal folds, of which the second from the axis is largest, sometimes a minute fourth fold at the periphery, and there is a short fold within the outer wall above it (fig. 11; in this example the third basal fold is longest, an exceptional condition). All of these folds are usually visible in an oblique view in the aperture, and also by transparence through the base.

Height 2.2, diam. 3.5 mm.; 5 whorls.

Japan: Yonezawa, Uzen (Y. Hirase).

This beautiful little snail is larger than others known from Asia—in fact, after the Endoplaces, the largest recent species of Strobilops. It is more depressed than *S. hirasei* and has more numerous basopalatal folds. It is closely related to the Korean *S. coreana,* but is much larger, with a relatively wider umbilicus. There is some variation in the basal folds (as in fig. 11) among the ten specimens examined, but most of them agree with the type.

Subgenus Discostrobilops, n. subg.

Gruppe der Strobilops uniplicata Wenz, Neues Jahrb. Min., Geol. u. Pal., 1915, II, p. 86.

The shell is thin, *strongly depressed,* the height less than half the diameter, subdiscoidal with well-opened umbilicus; finely costulate or rib-striate above, smoother beneath. Parietal lamella emerging; infraparietal lamella either wholly immersed or weak and emerging; deep within, the edges of the lamellæ are *either smoothish or sparsely prickly, without knots or nodes;* interparietal lamella either present or absent. *There is no columellar lamella.* Basal folds three or four. Type *S. hubbardi.*

Distribution: warm temperate to tropical parts of North America and the West Indies; Upper Oligocene and Miocene of Germany and Czechoslovakia.

This group comprises a single variable living species in America and one species, *S. uniplicata* (Sandberger), with two

subspecies, in central European Tertiary. In all of its characters the Tertiary species agrees so completely with the living *S. hubbardi* that the relationship appears to be well established. See Pl. 8, figs. 10-13, *S. uniplicata* (Sdbg.), Hydrobienschichten, Budenheim bei Mainz; Lower Miocene.

The parietal lamellæ of *S. hubbardi* generally appear to be smooth, but under a high power the rounded edge is seen in the most perfect specimens to bear irregularly and sparsely-placed little points directed towards the aperture and some minute granulation, but without a trace of nodes.

15. S. HUBBARDI (A. D. Brown). Pl. 7, figs. 1-3 (type).

The shell is subdiscoidal with very low spire, rounded periphery and convex, broadly umbilicate base; width of umbilicus contained 3⅔ times in that of the base. The whorls are strongly convex, increase slowly, and the last descends a little to the aperture. Surface light brown (opaque in the "dead" type, but when living doubtless glossy and somewhat translucent). Initial 1½ whorls pale, minutely granulose, the rest with slightly irregular sculpture of close, retractive riblets, about as wide as their intervals, weaker and partly obsolete on the base, where close, weak, microscopic spiral lines are seen. The aperture is rounded-lunate, the lip well expanded and thickened within. The parietal lamella is somewhat elevated and triangular, reaching the edge of the parietal callus. Infraparietal lamella very low, inconspicuous, weakly emerging, but not to the edge. Both enter slightly further than one-third of a whorl; between them near their inner ends there is a thread-like interlamellar lamella. At about a third of a whorl within there is a series of four basal folds: the first one situated where the basal curves into the columellar floor; the second, stout and erect, in the middle of the basal wall; the third one small; the fourth near the periphery and longer than the others.

Height 1.2, diam. 2.6 mm.; 4½ whorls. Type.

Texas: Indianola, Calhoun Co., in the coastal plain; forms of the species occur also in northeastern Mexico, Jamaica, Cuba, Bimini Islands on the western edge of the Bahamas, Bermuda, Florida, Georgia and Mississippi.

Helix hubbardi A. D. Brown, Proc. A. N. S. Phila., 1861, p. 333, text-fig.—*Strobila hubbardi* Binney, Terrest. Moll. V, 1878, p. 260, fig. 153; pl. 5, n. (dentition of a Georgia specimen).—W. Wenz, Nachrbl. D. M. Ges. 1916, p. 185.—*Strobilus huppardi* Clessin, Malak. Blätter, n. F. VII, p. 79.

Brown's type is a "dead" shell, drawn in Pl. 7, figs. 1-3. After these figures were drawn it was opened and found to have basal folds as described above, and like those of Pl. 8, fig. 9. The anterior part of the infraparietal lamella is very low. The interparietal lamella is delicate and thread-like but perfectly distinct, and by possessing this lamella, the type from the Texas coastal plain differs from all other *hubbardi* from Mexico, the West Indies and Florida which I have opened. The significance of this lamella is uncertain, in the absence of series from the coast of Texas. It may turn out to be merely occasional, and to be regarded as an atavistic mutation. If it is a constant character in this region, a separate subspecies is indicated. Temporarily, and in order to provoke further investigation, I am taking this view.

15*a*. *S. hubbardi vendryesiana* (Gloyne). Pl. 7, figs. 7, 8, 9 (topotype); figs. 4-6, 10-12. Pl. 8, figs. 1-9.

General shape as in *S. hubbardi;* light brown, glossy, finely costulate above, striate beneath. Infraparietal lamella either wholly immersed (as in Pl. 8, figs. 3, 4) or having a very low extension forward (as in Pl. 7, figs. 5, 7). *No interparietal lamella.* Basal folds typically *three* (Pl. 7, figs. 4, 7; pl. 8, fig. 7), but frequently four (Pl. 8, figs. 1, 8, 9). Lip narrow, but slightly thickened, more or less brown-tinted.

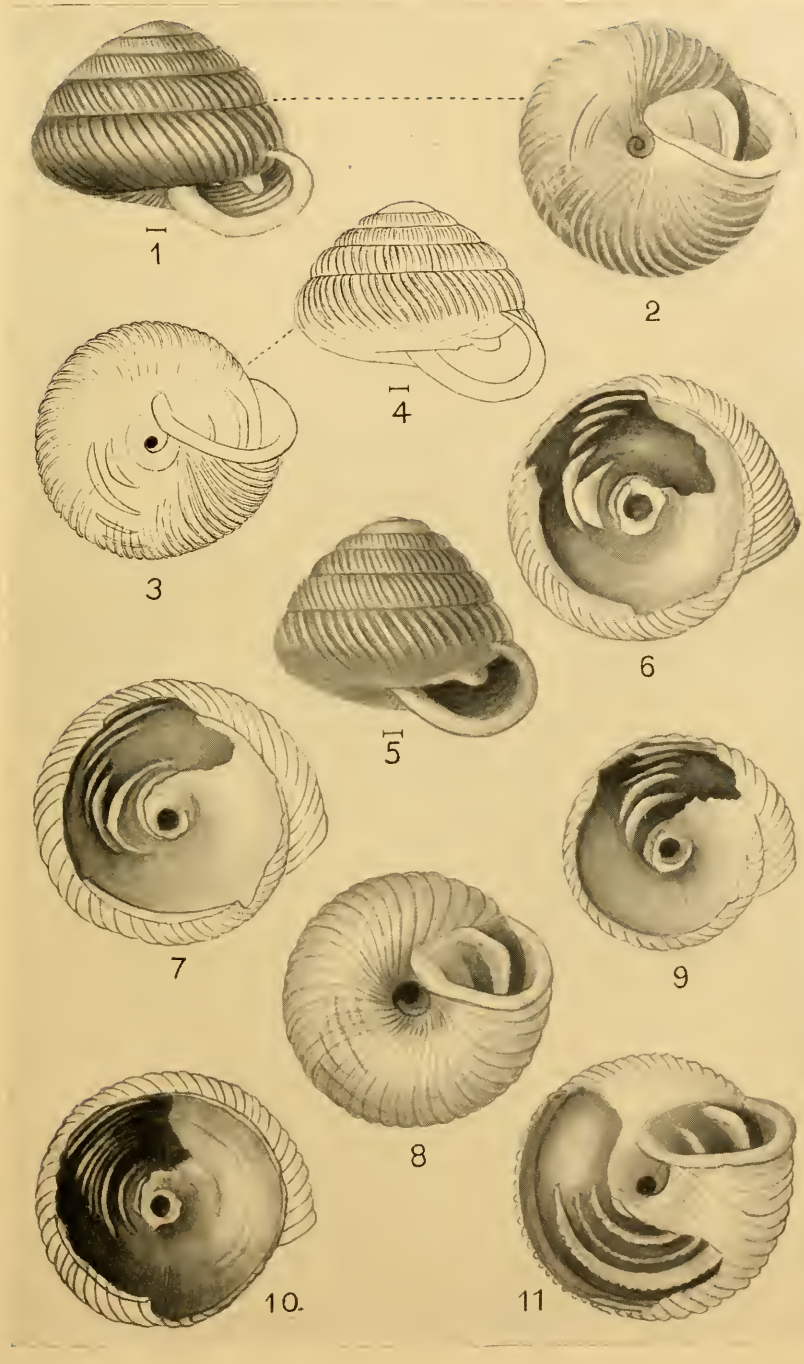
Height 1.05, diam. 2.6 mm.; 4½ whorls. Topotype.

Jamaica: Bellevue, St. Andrew, type locality (Gloyne, Bland and others).

Cuba: El Abra, Viñales (J. B. Henderson).

Bermuda: Admiral's Cave, Church Cave near Tuckerstown, Whitby Cave, Bailey's Bay, quarry between Tuckerstown and Walsingham (A. Gulick, S. Brown, A. Haycock, H. C. Hoyt).

Florida: Sugarloaf Key, Big Pine Key (Pilsbry); Lossman's Key (C. B. Moore); Miami (S. N. Rhoads); LaCosta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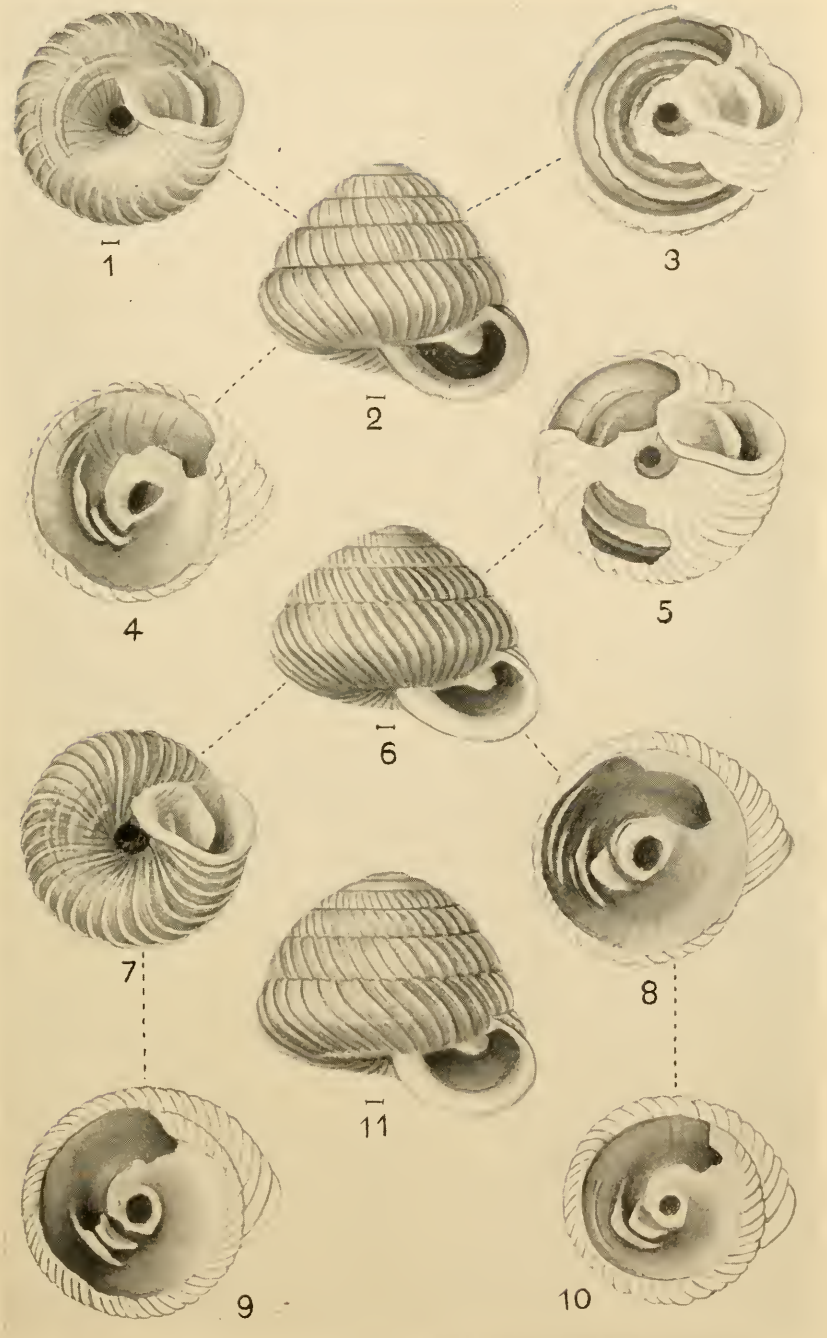
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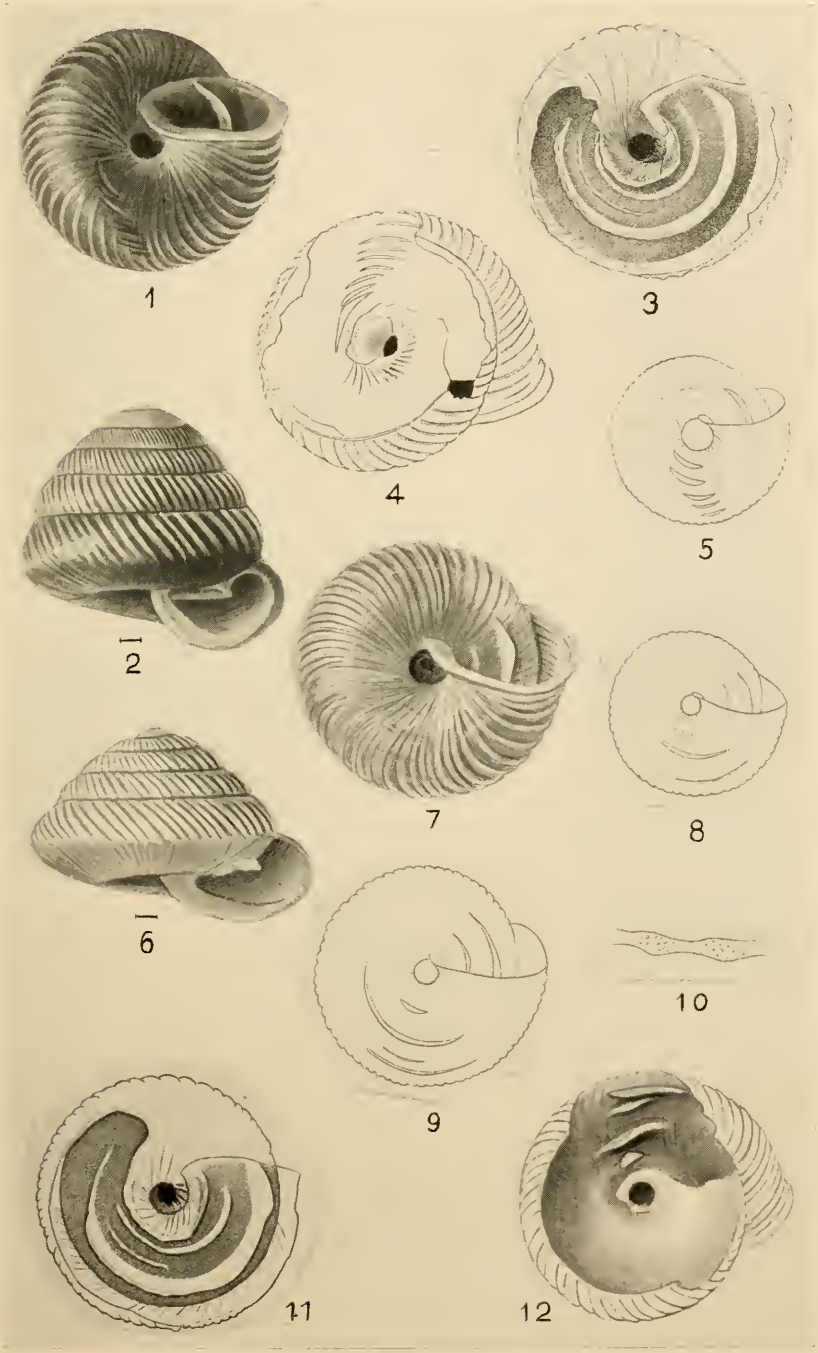
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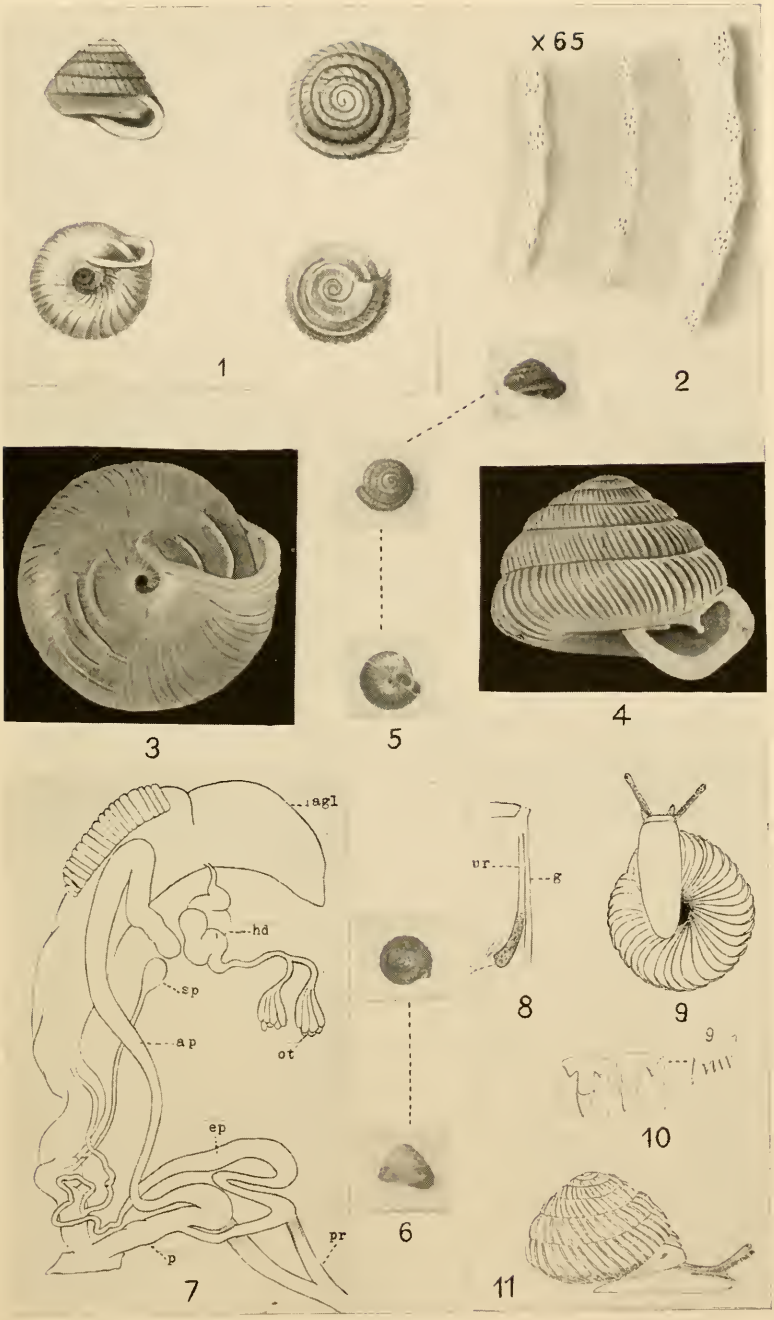
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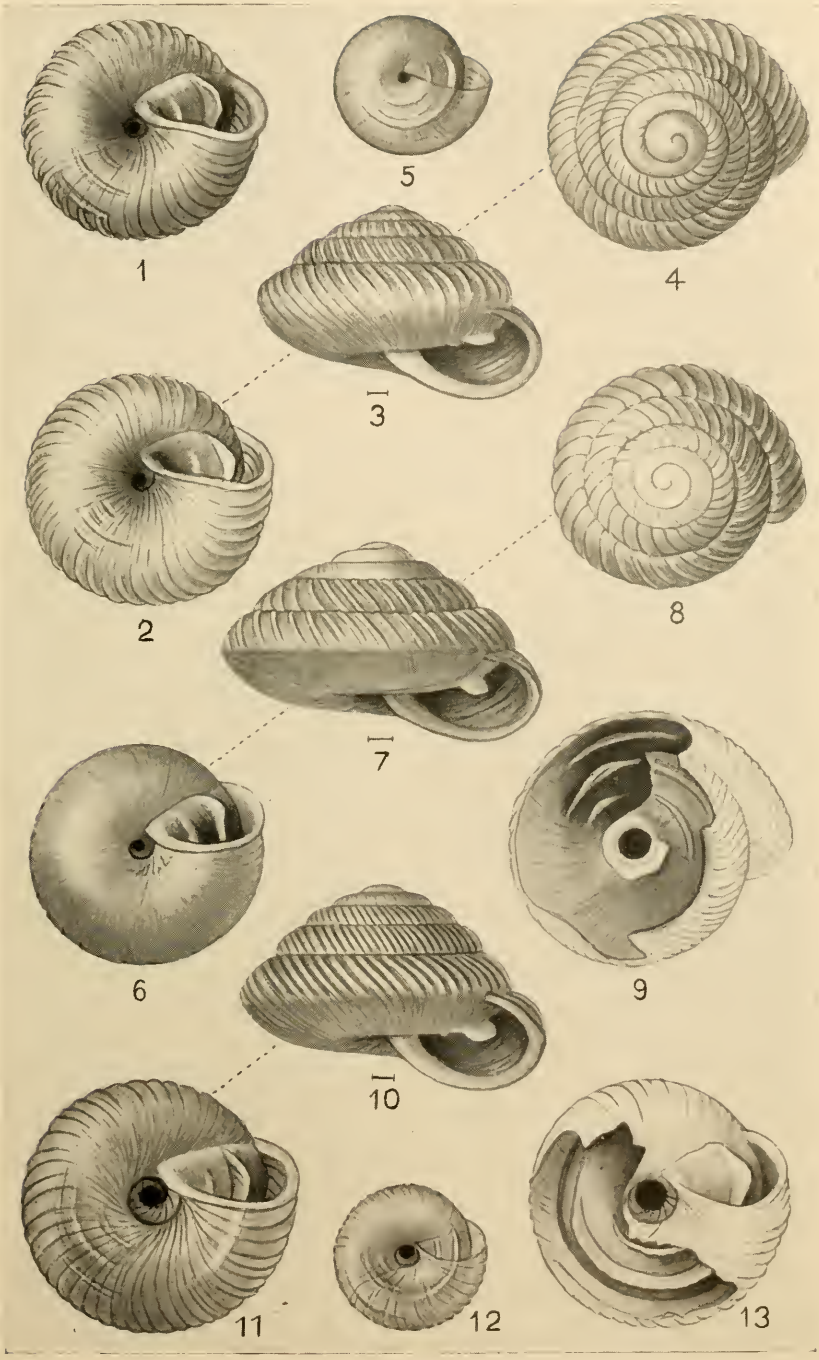
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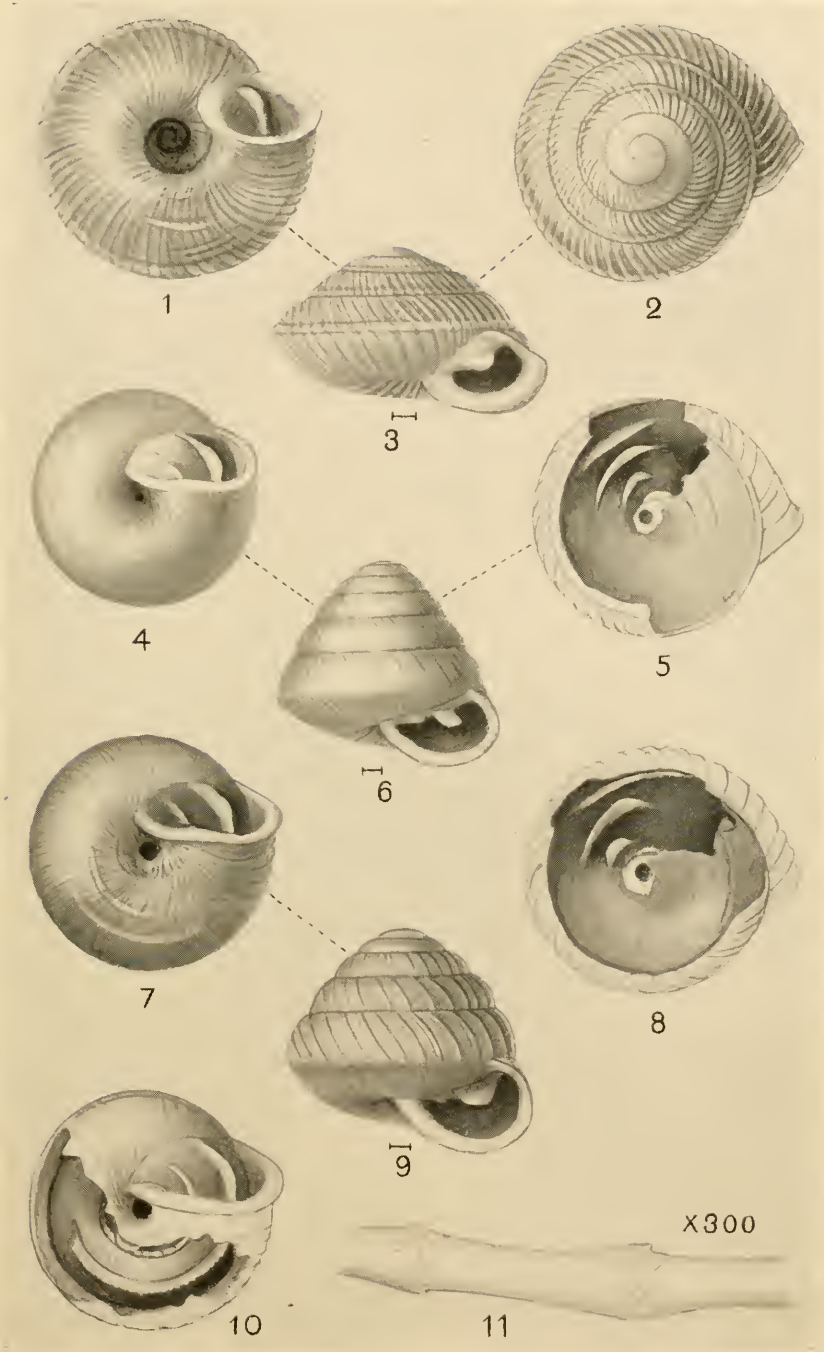
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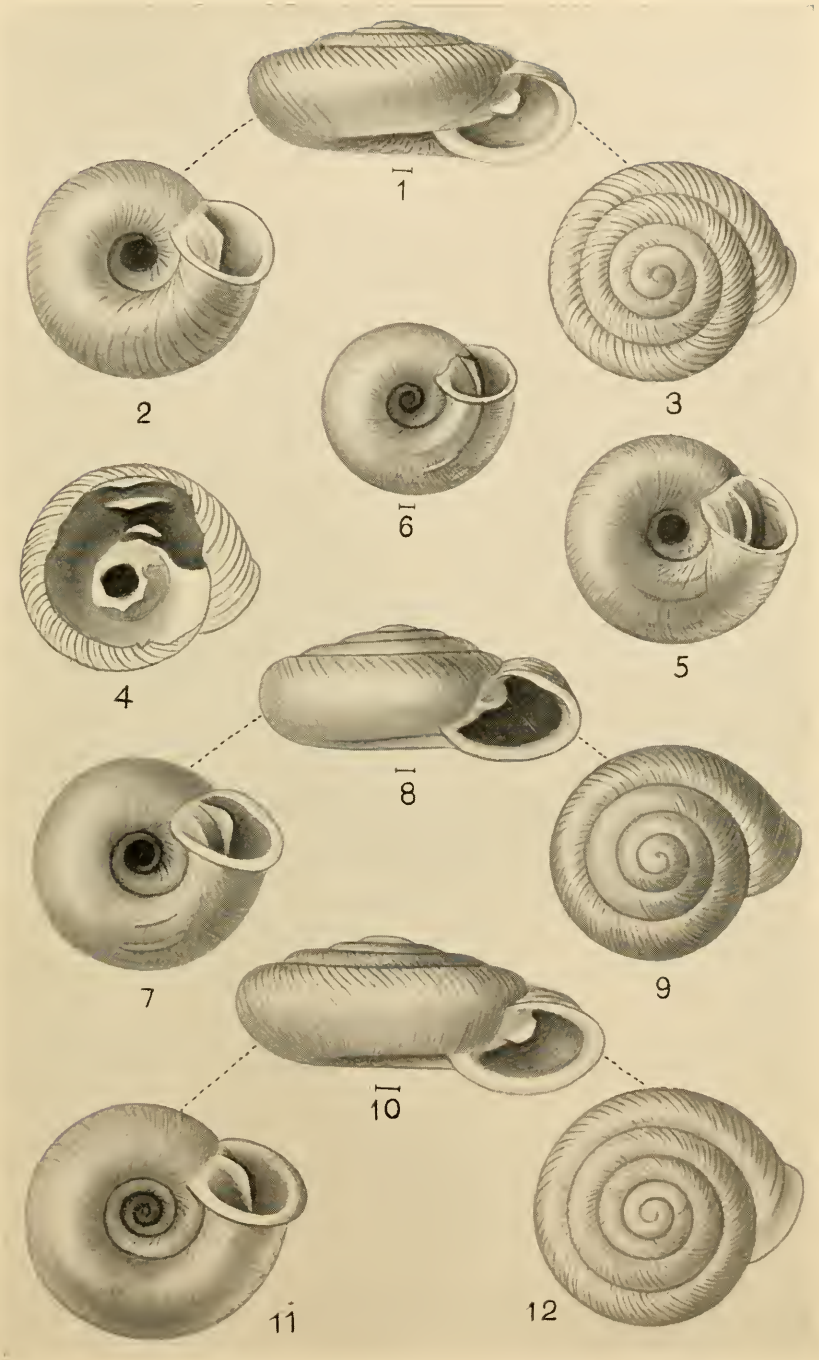
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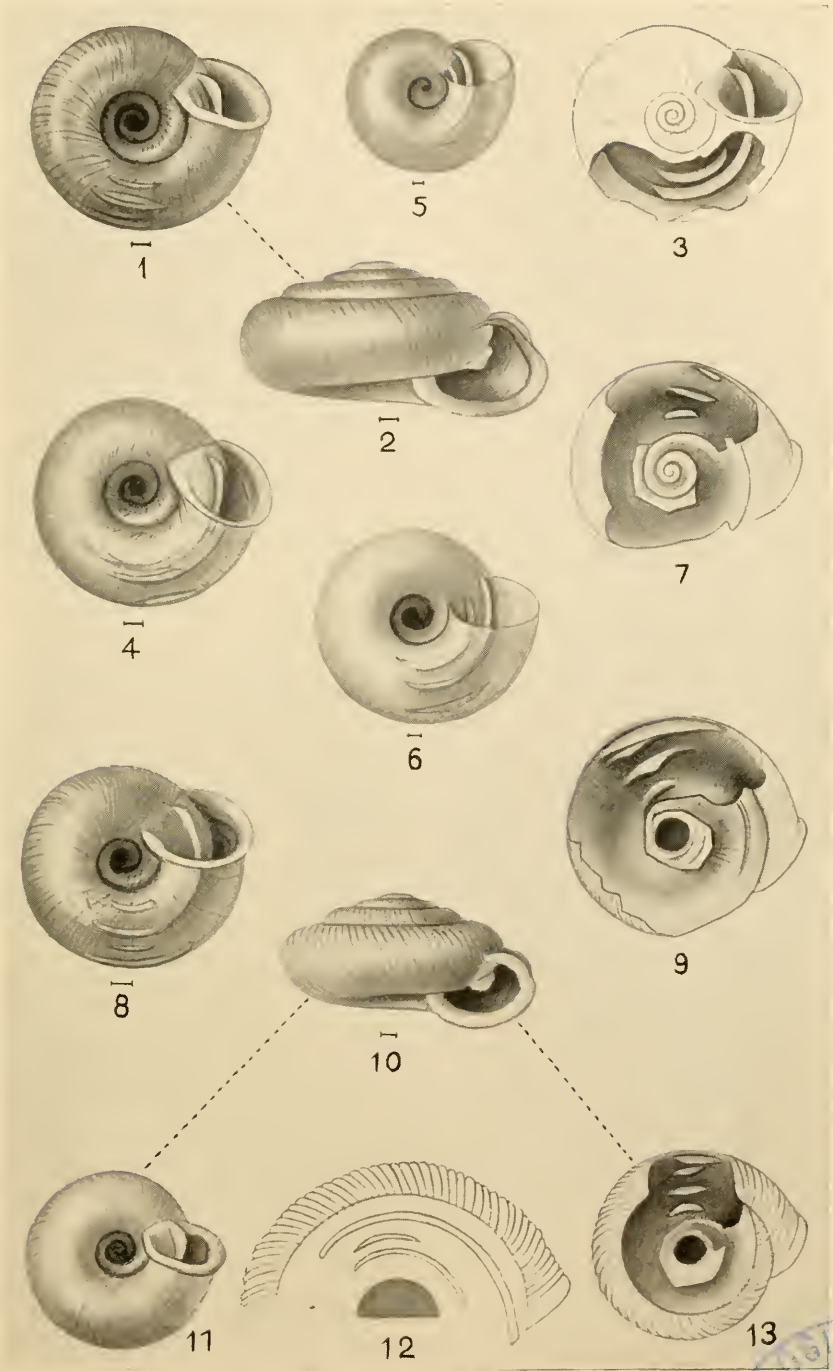

WOODS HOLE

Island, Demorey Key, Fikahatchee Key, Josselyn Key, Dismal Key, all in Lee Co. (C. B. Moore); Volusia Co. at Tick Island (Pilsbry and Johnson); and Lake Helen (G. W. Webster); near Gainesville (T. Van Hyning); St. Augustine (C. W. Johnson); Imri, Hamilton Co. (E. B. Chope). Mississippi: mouth of West Pascagoula River, Jackson Co. (C. B. Moore). Georgia: Bonaventure Cemetery near Savannah, according to W. G. Binney.

Mexico: Tampico and Valles, S. L. Potosi (A. A. Hinkley).

Helix vendryesiana Gloyne, Journ. de Conchyl. XIX, 1871, p. 333.—*Strobila hubbardi* C. W. Johnson, Nautilus III, p. 20. — G. W. Webster, *Naut.* VII, pp. 84, 94 (variation in teeth). — *Strobilops hubbardi* Gulick, Proc. A. N. S. Phila. 1904, p. 413 (Bermuda, fossil).—Verrill, Trans. Conn. Acad. Sci. XII, p. 168, f. 53 (not uncommon living, Bermuda).—G. H. Clapp, Naut. XXVII, p. 64 (Bimini Is.).—J. B. Henderson, Naut. XXVII, p. 41 (many localities in Havana and Pinar del Rio provinces, Cuba).—Hinkley, Naut. XXI, p. 76 (Mexico).—Walker, Naut. XXXI, p. 56 (Palm Beach, Fla.). —Vanatta, Nautilus XXI, p. 100; XXVI, pp. 12, 19, 32; XXXIII, p. 18 (distribution in Florida). — *Strobilops hubbardi stevensoni* Pilsbry, Proc. A. N. S. Phila., 1899, p. 404.—Rhoads, Nautilus XIII, p. 46 (under bark of dead limbs in a mangrove swamp, Biscayne Bay near State Agricult. Sta., Miami, Florida).

Specimens from Cuba (Pl. 7, fig. 6, El Abra, Viñales, Province of Pinar del Rio) are small, as Henderson has remarked. The one figured measures 2 mm. diameter with 4⅓ whorls. Sculpture weak.

The form found in Bermula (Pl. 7, figs. 10, 11, 12) is large with the lip somewhat more thickened than usual. There is no interparietal lamella. The umbilicus is wider than in other lots, but somewhat variable; in a specimen 2.85 mm. diameter the umbilicus is contained only 2¾ times.

In Florida (Pl. 8, figs. 1-6, Miami; 8, 9, Lake Helen) the species appears to be generally spread. The parietal lamella is low, the infraparietal generally not emerging though it becomes high far within. There are generally three basal folds (Pl. 8, fig. 7), but often four (Pl. 8, fig. 9), and in rare cases

five folds are seen in immature shells (Pl. 12, fig. 9, Lake Helen, Florida).

In a young shell from Miami 1.2 mm. diameter (Pl. 8, fig. 5) there are no basal folds, but the two parietal lamellæ are well developed. Folds are present but small in a shell 1.5 mm. diameter, and at 2.2 mm. (Pl. 8, fig. 6) they are longer than in an adult of the same lot (Pl. 8, fig. 7).

Mexican specimens from Tampico (Pl. 7, fig. 5) and from Valles, San Luis Potosi (Pl. 7, fig. 4) are like those of Jamaica; the few seen have three basal folds.

The form I described as *S. hubbardi stevensoni* (Pl. 8, figs. 1-7) is identical with *vendryesiana*. It was distinguished from *hubbardi* by the smooth base, somewhat wider umbilicus and three basal folds — the type of *hubbardi* having more basal sculpture and four folds. Large series which I have examined and opened appear to show that the characters relied upon are inconstant, and moreover, are those of *vendryesiana*.

Subgenus Enteroplax Gude.

Enteroplax Gude (as a section of *Plectopylis*), Science Gossip VI, October, 1899, p. 149. Type by original designation *P. quadrasi*.

The shell is thin, low conoidal to almost discoidal in form; the *edge of the parietal callus thickened and raised,* prominent where the parietal lamella joins it; infraparietal lamella emerging, both lamellæ with smooth or serrate (not nodose) edges, and penetrating a half whorl; usually there is a low radial callus across the parietal wall at their inner ends. There is *no columellar lamella.* A radial series of few or many basal folds is immersed from a fourth to a third of a whorl back from the peristome. Soft anatomy unknown.

Distribution: Philippine Islands.

This little group is well characterized by the raised parietal callus, somewhat like that of the typical Polygyras, and the absence of a columellar lamella, as in *S. hubbardi* of the Section Discostrobilops. The parietal lamellæ are either smooth at the edge, as in some Tertiary species of *Strobilops,* or the

rounded edge is set with many low microscopic teeth pointing towards the aperture, sometimes subobsolete, but evenly distributed, *not* gathered upon nodes as they are in typical *Strobilops*. This is also a character of *Discostrobilops*, which on the whole seems to be the most nearly related group. No closely related fossil species have been found, and as Wenz remarks, they are hardly to be expected. The group may very likely have been evolved locally in its present area. All the known species are quite thin shells having a delicate peripheral carina over which the riblets of the upper surface do not pass.

These forms were first found by Dr. O. von Moellendorff when on a collecting trip in Cebu in company with O. Koch, a compatriot settled there and working up the butterfly fauna. They ascended Mt. Licos, estimated to reach a height of about 500 meters, a peak circled by precipitous crags and a girdle of high forest springing from a slope strewn with great blocks of rock and rubble. Here in clefts and crevices of the rocks, often reached by standing insecurely on the shoulders of his guide, von Moellendorff found the Enteroplaces, Aulacospiras and many other new snails. "None of my finds," he writes, "have given me such joy as this one and the following (*S. polyptychia* and *trochospira*), secured almost at the peril of my life."

Key to Species of the Philippine Islands.

1. Form subdiscoidal, with weakly convex spire and a series of about 10 short basal folds. Cebu.
   S. polyptychia, No. 16.
   Form low-trochoidal; fewer basal folds (2).
2. Four or five basal folds (3).
   Three basal folds; diam. 3.4 to 3.7 mm. Northern Luzon.
   S. quadrasi, No. 19.
3. Diam. 4 mm.; a low interparietal lamella extending inward beyond the two parietals. Cebu. *S. trochospira,* No. 17.
   Diam. 3.2 to 3.7 mm.; a low radial callus extending across the wall at the inner end of the two parietals. Bohol.
   S. boholensis, No. 18.

16. STROBILOPS POLYPTYCHIA (Mlldff.). Pl. 12, figs. 14, 15, 16.

Shell openly umbilicate, discoidal, closely costulate above, striatulate beneath, brown. Spire slightly raised; whorls 5½ to 6, nearly flat, the last subacutely angular at the periphery and somewhat so around the umbilicus. Aperture diagonal, obliquely heart-shaped, the peristome continuous, free, expanded, a little reflected and thickened within; parietal margin deeply sinuate. Two parietal lamellæ, one extending to the edge of the peristome, the other falling a little short of it, both penetrating inward to the middle of the whorl. Nine or ten short palatal lamellæ situated at the third part of the last whorl. Height 1¼, greater diam. 3½, lesser 3 mm. (*Mlldff.*).

Cebu: peak of Mount Licos (Moellendorff).

Plectopylis polyptychia MOELLENDORFF, Jahrb. D. Malak. Ges. XIV, 1887, p. 272, pl. 8, f. 8-8*c*.; Abh. d. naturf. Ges. Görlitz, 1897, p. 147.—GUDE, Science Gossip, IV, September, 1897, p. 102, fig. 55*a-d*.

The parietal and infraparietal lamellæ enter fully a half whorl; between, above and below their inner ends is a low white callus forming somewhat triangular lobes with inwardly directed angles in the intervals, its surface only weakly granular. The edges of the parietal lamellæ appear under a high power to be smooth and rounded. The ten basal folds within the last third of the last whorl are short, slightly unequal, and form a close series from the foot of the columellar wall to the periphery. Two specimens measure:

Height 1.8, diam. 4.3 mm.; 5⅔ whorls; umbilicus contained 2⅔ times in diameter.

Height 1.5 diam. 4 mm., 5½ whorls; umbilicus contained about 3 times in diameter.

It is much lower than other species, with a more broadly open umbilicus and more numerous baso-palatal folds (fig.14).

17. STROBILOPS TROCHOSPIRA (Mlldff.). Pl. 11, figs. 5*a-c*, 6*a-e*.

Shell openly and perspectively umbilicate, depressed-conoid, costulate above, striatulate below, corneous, with conoidal spire. Six slightly convex whorls, the last rather acutely

carinate at the periphery, obtusely angular around the umbilicus. Aperture diagonal, lunar, the peristome thickened within, expanded and slightly reflected, margins joined by a callus. Two parietal lamellæ, one reaching the edge of the parietal callus, the other stopping a little short of it; both penetrating deeply inward; at a third of a whorl within are 5 or 6 thin, rather long lamellæ on the palatal margin opposite (*Mlldff.*).

Height 2¼, diam. 4 mm. (*Mlldff.*).

Cebu: peak of Mt. Licos (Moellendorff).

Plectopylis trochospira Moellendorff, Jahrb. D. Malak. Ges. XIV, 1887, p. 273, pl. 8, figs. 9-9*c*; Abh. d. naturf. Ges. Görlitz, 1897, p. 148.—Gude, Science Gossip, IV, March, 1898, p. 285, fig. 73.

I have not seen this species, of which Gude writes:

"The aperture is diagonal, lunate; the peristome white, a little thickened and reflexed, the margins being slightly convergent and united by a scarcely raised sinuous ridge at the parietal callus. The parietal armature consists of two long, parallel, horizontal folds, which revolve over nearly half a whorl, the upper one being the stronger and united to the ridge at the aperture, while the lower one is thinner and terminates at a short distance from the ridge; a very thin, short, horizontal fold occurs posteriorly a little below the upper fold (see fig. 6*e*, which shows the parietal wall of the shell with its folds).

"The palatal armature is composed of five short, thin, horizontal folds, which descend a little anteriorly (see fig. 6*d*, which shows both the parietal and the palatal armature from the posterior side). The specimen figured is in the collection of Professor Oscar Boettger, of Frankfort, by whom this shell —which measures: major diameter, 4 millimeters, minor diameter, 3.5 millimeters; altitude, 2 millimeters—was obligingly lent to me.

"*Plectopylis trochospira* is allied to *P. quadrasi*, but it is larger and much lighter in color; there are also certain differences in the armature" (*Gude*).

18. STROBILOPS BOHOLENSIS (Gude). Pl. 11, figs. 1-4, 7-10.

Differs from the type (*S. trochospira*) in being smaller and having a narrower umbilicus. Major diameter 3.25 mm., minor diameter 3 mm., latitude 1.75 mm. The armature is nearly identical, but the palatal folds are connected at their posterior terminations by a very slight transverse sinuous ridge, plainly discernible externally through the shell wall (*Gude*).

Philippine Is.: Bohol. Type in Mr. Ponsonby's collection (now contained in that of Bryant Walker).

Plectopylis trochospira var. *boholensis* GUDE, Science Gossip, IV, March, 1898, p. 285, fig. 74.

In the Ponsonby Collection, now contained in that of Bryant Walker, there are two specimens, No. 62067, one of which, measuring height 1.95, diam. 3.3 mm., barely 6 whorls, I presume to be the type. The slight discrepancy in size — one-twentieth of a millimeter in the diameter, two-tenths in the height—might easily be due to differences in method of measuring, especially in the height, where the points measured are far out of alignment. The umbilicus is contained 3¼ times in the diameter; the ribs are well developed within its opening. The two lamellæ of the parietal wall slightly exceed half a whorl in length; near the inner ends a low radial callous band connects them. Their edges are serrate, as described below. There are five basal folds, the one nearest the columella small, the second and fourth larger; there is a callous ridge connecting their inner ends. The parietal callus is less raised than in other species of *Enteroplax*.

In this form there is no interparietal lamella between and beyond the inner ends of the parietals, such as Gude figured for *S. trochospira*. If the latter normally has this structure, the Bohol form must be specifically distinct.

In other lots from Bohol (A. N. S. P. No. 78457 and B. Walker Coll. No. 32117, Sierra Bullones), out of the Quadras collection, the shell is larger (Pl. 11, figs. 8, 9, 10).

Height 2.2, diam. 3.7 mm. 78457.

Height 2.25, diam. 3.5 mm.
Height 2.3, diam. 3.6 mm. } 32117.

The umbilicus is contained 3½ times in the diameter. The internal structure is like the type of *boholensis*. The parietal lamellæ are slightly more than a half-whorl long, with an irregular, smooth, radial callous band across the parietal wall at their inner ends. Under a high power the rounded edge of each lamella is seen to be closely set with short prickles directed toward the aperture, so that in profile view the appearance is that of a fine but irregular saw (Pl. 11, fig. 7). These disappear towards the aperture, and are well developed only near the inner ends of the lamellæ.

19. STROBILOPS QUADRASI (Mlldff.). Pl. 11, figs. 11, 12, 13, 14.

Shell rather openly umbilicate, conoid-depressed, thin, costulate above, striatulate beneath, corneous-brown; spire little elevated, with slightly convex lateral outlines; whorls 6, a little convex, separated by an impressed suture, the last rather acutely carinate at the periphery, obtusely angular around the umbilicus. Aperture diagonal, irregularly heart-shaped; peristome moderately expanded, strongly lipped within, brown, the margins connected by a strong callus which is somewhat deeply sinuate at the insertion of the outer margin and lamellarly raised. There is a high upper parietal lamella joined to the callus and a lower one not reaching the callus, both entering deeply, and opposite them, a third of a whorl within, three rather strong and long palatal lamellæ. Height 1.75, diam. 3.5 mm. (*Mlldff.*).

Northern Luzon: village of Siamsiam (J. Quadras); Sitio Cobayo, Palanan (Quadras).

Plectopylis quadrasi MOELLENDORFF, Nachrichtsblatt D. Malak. Ges XXV, December, 1893, p. 172; Abhandl. naturf. Ges. Görlitz, XXII, 1898, p. 148.—GUDE, Science Gossip, IV, August, 1897, p. 71, fig. 54*a-e*.—*Strobilops* (*Enteroplax*) *quadrasi* Mlldff. and var. *brunescens* Mlldff., WENZ, Nachrbl. d. m. Ges. 1916, p. 189.

The parietal lamellæ enter half a whorl, and towards the inner end their edges are set with low, rather blunt asperities or granules, less developed than in *S. boholensis*. Across the parietal wall and connecting the inner ends of the parietal

lamellæ there is a low whitish callus, irregularly trilobed inwardly, and on the apertural side having some tubercles along V-shaped sinuses, or sometimes this pattern is not distinct. The three thin, short and rather high basal folds, the middle one largest, have their inner ends united by a low and narrow, irregularly-festooned radial callus. The size of the shell is somewhat variable.

Height 2.4, diam. 3.7 mm.; 6 whorls; umbilicus contained 3¼ to 3⅓ times in diameter.

Height 1.9, diam. 3.4 mm.; 5½ whorls; umbilicus contained about 3⅕ times in diameter.

Wenz mentioned a var. *brunescens* Mlldff., which, so far as I know, has not been described. Specimens before me so labelled do not appear distinguishable from those received as typical *quadrasi*.

APPENDIX TO STROBILOPSIDAE.

Species discovered since the publication of the classification of Strobilops necessitate an extension of the synopsis of subgenera and sections given on page 18 and of the key to Mexican and Central American species on page 32.

Key to Subdivisions of Strobilops.

1. Parietal callus having a thickened, raised edge, prominent where the parietal lamella joins it; parietal lamellæ with smooth or microscopically serrate edges, not nodiferous; shell thin, carinate. Philippines.

   Subgenus ENTEROPLAX, species Nos. 16-19.

   Parietal callus not noticeably thickened or raised *at the edge*. (2)

2. Spire conoidal. (3)

   Subdiscoidal, the spire low, periphery rounded, umbilicus wide; parietal lamellæ with sparsely prickly or smoothish edges, not nodiferous.

   Subgenus DISCOSTROBILOPS, species 15.

3. Umbilicus large, contained 3 or 4 times in the diameter (4)

   Umbilicus decidedly smaller. (5)

4. Spire rather highly conic, of 5½ to 6 closely coiled whorls; parietal lamellæ with nodes.
Section *Coelostrobilops,* species 7, 22.
Spire low conic, of 4½ whorls; lamellæ of parietal wall without nodes; no columellar or interparietal lamellæ.
Section *Nesostrobilops,* species 10.
5. Upper surface finely striate; no interparietal lamella.
Section Eostrobilops, species 11-14.
Upper surface costulate (except in *S. morsei,* which is nearly smooth); an interparietal lamella present.
Section Strobilops *proper,* species, 1-9, 20, 21.

The following grouping will replace that given at the top of page 18.

Strobilops { S.-g. Strobilops ..... { Section Strobilops s. s. / Section Coelostrobilops. / Section Nesostrobilops. / Section Eostrobilops.
S.-g. Discostrobilops.
S.-g. Enteroplax.

Species of Mexico, Central America and West Indies.

The following key is to be substituted for that on page 32.

1. Form approaching discoidal, the height about half the diameter; umbilicus contained 3 to 4 times in diameter.
S. hubbardi, No. 15.
Higher, the spire conic or conoidal (2)
2. Umbilicus large, nearly one-third the diameter (3)
Umbilicus decidedly smaller (4)
3. Periphery strongly angular. Guatemala. *S. salvini,* No. 7.
Periphery rounded. Grand Cayman I. *S. wenziana,* No. 22.
4. Umbilicus small, contained 10-12 times in the diameter (5)
Umbilicus contained about 5-6 times in the diameter; 3 or 4 basal folds (6)
5. Shell low conic *S. strebeli,* No. 5.
Spire elevated, the height 80 to 90 percent of the diameter
S. veracruzensis, No. 6.
6. Outer basal fold weakly developed (or sometimes wanting?); Socorro Island *S. hannai,* No. 21.
Outer basal fold well developed (7)

7. Low conic; 3 basal folds. Mexico.
S. aenea mexicana, No. 4c.

Rather high conic; 3 basal folds and one above periphery. Old Providence Island *S. piratica,* No. 20.

20. STROBILOPS PIRATICA, Pils. Pl. 13, figs. 8, 9, 10, 11.

The shell is conic with the lateral outlines of the spire somewhat convex; umbilicate, the width of umbilicus contained 5 to 6 times in the diameter of the shell. There are 5½ whorls, the first 1½ smooth, the rest with sculpture of retractive riblets, which are about half as wide as their intervals on the penult whorl; on the last whorl they are somewhat unevenly spaced, partly closer. They pass over the periphery and continue over the base. The periphery is weakly subangular in front of the aperture, elsewhere rounded. The aperture has a blunt, weakly expanded lip and a moderately strong parietal callus. The parietal lamella is strongly developed and penetrates inward slightly more than a half whorl. Its slightly thickened edge has swollen nodes bearing minute points and granules. The infraparietal lamella penetrates inward nearly as far as the parietal, is similarly nodose and emerges very weakly. There is a short interparietal lamella consisting of a series of tubercles weakly connected. The palato-basal barrier, situated nearly a half whorl inward, consists of four folds: three in the basal wall, the middle one much the higher, the outer one narrow and low, and one small, very narrow fold above the periphery.

Height 2 mm., diam. 2.2 mm.

Old Providence Island: on the summit of the ridge north of High Peak, in leaf debris of forest. Type No. 150860 ANSP, paratypes No. 150862.

Strobilops piratica PILSBRY, Proc. A. N. S. Phila., vol. 82, p. 256, pl. 19, figs. 9-11. July 18, 1930.

This species has a higher, more convexly conic shape than *S. veracruzensis,* with a wider umbilicus. By the possession of a palatal fold above the periphery and of ribs on the base it differs from the Mexican forms, and resembles some northern

species, such as *S. texasiana*. It differs from that species by the weaker ribs and wider umbilicus among other features.

I obtained no living specimens of this little snail, and indeed did not see it in the field. Three entire and three broken examples were found in leaf debris gathered on the ridge running north from High Peak. (*Piratica*, belonging to pirates—who used this island as a base after Morgan wrested it from the Spaniards.)

21. STROBILOPS HANNAI, new species. Pl. 16, figs. 3, 3*a*, 4.

The shell has a dome-shaped spire of closely coiled, moderately convex whorls, a bluntly but distinctly angular periphery and moderately convex base. Umbilicus contained about 6¼ times in the diameter. Color deep olive-buff, rather dull above, glossy at the base. Sculpture: the first 1½ whorls smooth, the rest with retractive ribs about half as wide as their intervals. Most of these ribs disappear after passing over the periphery, but some continue diminished over part of the base, and a few weakly to the umbilicus. The aperture is lunate, oblique. Lip is white, moderately expanded, thickened within. The parietal callus is thick. The parietal lamella is strong, emerges to the edge of the callus, and penetrates half a turn. Infraparietal lamella also penetrates as deeply as the parietal, is rather high at the inner end but weakens further forward, not emerging in the aperture. Both of these lamellæ have strong nodes which are profusely, shortly spinose. There is a low interparietal lamella between the inner ends of the large lamellæ. There appears to be no columellar lamella. Basal folds three: the inner or fold 1 is well developed but short; fold 2 is larger; the third fold is very small and thin (it apparently represents either No. 4 or 5 of the diagram on page 2; in a second specimen it could not be seen, but possibly was broken away in opening the shell).

Height 1.7, diam. 2.4 mm.; 5½ whorls. Type.

Height 1.5, diam. 2.2 mm; 5½ whorls.

Socorro Island, off western Mexico, at 2000 feet (G. D. Hanna).

Strobilops labyrinthica Say, DALL, Proc. Cal. Acad. Sci. (4), vol. 15, No. 15, 1926, p. 480.——? *Strobilops strebeli* Pfeiffer, DALL, *l. c.*

This species differs from *S. labyrinthica* (Say) by the smaller number of basal folds and absence of any above the periphery of the cavity, among other differences. It is closely related to *S. strebeli* and *S. aenea.* The former has a smaller umbilicus, and both differ from *S. hannai* by the *strong development of the outer basal fold,* which is very weak in the Socorro Island form. *S. strebeli guatemalensis,* which resembles *S. hannai* by its angular periphery, has a far smaller umbilicus, contained about 10 times in the diameter.

It is named for Dr. G. D. Hanna, who collected the specimens.

I have not seen the single specimen which Dall identified as *S. strebeli,* but I suspect that it will prove to belong to the present species. Dall apparently did not open the shells for examination of the internal armature.

STROBILOPS STREBELI GUATEMALENSIS *Hinkley.* Page 35, 2d line.

The dimensions of the type should be: Height 1.4 mm., diam. 2.4 mm.

Section COELOSTROBILOPS, n. sect.

Conic strobilops with broadly open umbilicus, contained 3 to 4 times in the diameter. Type *S. wenziana.*

Strobilops salvini (Tristr.), p. 37, belongs to this group.

22. STROBILOPS WENZIANA Pilsbry. Plate 13, figs. 1-7.

The shell is conic with blunt apex, nearly straight lateral outlines and rounded periphery, below which it is flattened between periphery and the strong basal convexity around the umbilicus; openly umbilicate, the width of umbilicus contained nearly three times in that of the shell. There are 6 convex whorls, the first two smooth, the rest sculptured with narrow retractive ribs, separated by spaces averaging on the last whorl three times as wide as the ribs. Most of the ribs

stop at the periphery, but a few on the last half whorl continue over the base; they reappear in the umbilicus. The aperture is lunate, the outer and basal margins about equally curved, expanded a little, strongly thickened within. The parietal lamella is strong and penetrates inward almost an entire whorl. The infraparietal lamella emerges and is broad and united with the parietal by a callus at the end; it penetrates as far as the parietal. Under a high power the edges of both lamellæ show very indistinct swellings or nodes, which are slightly roughened. The inner end of the parietal has more distinct serration. There is no interparietal lamella. Within the base, slightly more than a half whorl behind the aperture, are two basal folds, corresponding to those numbered 1 and 2 in the diagram of strobilopsid teeth (see p. 2, fig. 1)., the inner one is lower than the strong outer one, and only about half as long (fig. 5). No columellar lamella seen.

Height 2 mm., diam. 2.7 mm.; umbilicus 1 mm. Type, figs. 1-3.

Height 1.9 mm., diam. 2.4 mm. Figs. 6, 7.

Heights 2.1 mm., diam. 2.8 mm.

Grand Cayman Island, about midway between North Sound and Red Bay. Type 150861 A. N. S. P. (Pilsbry).

Strobilops wenziana Pilsbry, Proc. A. N. S. Phila., vol. 82, p. 238, pl. 19, figs. 1-7, July 18, 1930.

This species can be compared only with *Strobilops salvini* (Tristram) of the mountain forests of Vera Paz, Guatemala, which has a similarly wide umbilicus. I have not seen that species, but it is said to be angular peripherally, of 5½ whorls, with only one lamella emerging on the parietal wall (the infraparietal being shorter). The shape of the aperture is quite different, according to the figure of the type given by von Martens. Unfortunately, the internal armature of *S. salvini* has not been fully described. I have seen all other American species of the genus, and none is at all like *S. wenziana.*

This is the only West Indian *Strobilops* of the conic group. Its presence on Grand Cayman is the most surprising occurrence in the West Indian land snail fauna which has turned

up in a long time. I am naming it in honor of my friend Dr. W. Wenz of Frankfurt a.M., whose work on the Tertiary Strobilops of Europe has contributed materially to our understanding of this ancient group.

Section NESOSTROBILOPS, n. sect.

Strobilops with conic spire of few (4½) whorls, the parietal lamellæ without nodes; no interparietal lamella and no columellar. Basal folds 3 or 4. Type *S. helleri.*

The only species known of this insular group resembles *Discostrobilops* in having no columellar lamella, fewer whorls than in other *Strobilops,* and with the internal barrier less deeply immersed, so that the folds can be seen in an oblique view in the aperture. Also, there are no nodes on the parietal lamella, though it is microscopically roughened.

10. STROBILOPS HELLERI (Dall). Pl. 16, figs. 1, 1*a*, 2, 2*a*.

See this vol., p. 41, where the type was described and figured. The California Academy Expedition collected specimens at the following places: Albemarle Island near Cowley Mountain on moist ground at 350 to 500 feet; on Narborough in grass and bushes at the rim of the crater at 4000 feet; and on James Island, in moist grass and bushes at 1800 to 2000 feet (*W. H. Ochsner*), in Dall and Ochsner, Proc. Cal. Acad. Sci. (4), vol. 17, p. 176, 1928.

Through the courtesy of Dr. G. D. Hanna of the California Academy of Sciences I have obtained specimens of Strobilops from Narborough and James Islands. The Narborough shell (pl. 16, figs. 1, 1*a*) is barely mature, being still somewhat transparent, with the lip somewhat expanded, but little thickened. The base is finely striate, not ribbed, but ribs reappear within the umbilicus. The peripheral carina is not distinctly bordered above and below, as in the type specimen from southern Albemarle. There are four basal folds, the fourth (nearest the periphery) being longest, the second next, the first and third shorter and about equal in length, though the first is stouter (Pl. 16, fig. 1). The parietal lamella extends inward very little beyond the basal armature; its inner half

accompanied by a short infraparietal lamella, about as figured for *S. hubbardi* in pl. 8, fig. 3. These lamellæ have no nodes or knots, but there is a weak microscopic roughening of the edge about as described for *Discostrobilops* on page 47. I could not get the objective near enough to determine the exact structure without breaking the whole base. Height 1.7 mm., diam. 2.9 mm., umbilicus 0.75 mm.

The James Island specimen (Pl. 16, figs. 2, 2*a*) is fully mature and opaque. It also is striate basally, but the striae in part are somewhat thread-like, with ribs within the umbilicus and a few near the lip. The expanded lip has a white thickening. There is no little fold between the second and outer basal folds. The parietal lamella, as in the Narborough shell, does not penetrate more than a third of a turn. The infraparietal reaches weakly almost to the aperture. Height 1.9, diam. 2.9 mm.

There appear to be some small differences in form and sculpture between the shells from different islands, but until longer series are at hand for comparison it is not certain that they have racial significance.

APPENDIX TO PUPILLIDÆ

GASTROCOPTA (Vol. 24, p. 6).

Vol. 24, p. 8. The status of *Leucochilus* Boettger (1881, type *Pupa armifera* Say) was left uncertain in the place cited. This case has now been considered by the International Commission on Nomenclature in Opinion 115, and the following conclusion reached.

"The Commission herewith suppresses *Leucochilus,* 1881, in favor of *Leucochila,* 1860. Any other course would involve risk of lasting and constant confusion in two rather closely allied genera."

Vol. 24, p. 117, add to fossil species: *Gastrocopta fissidens infrapontica* Wenz, Senckenbergiana vol. 9, 1927, p. 47, pl. 2, f. 8. Pliocene: Pontian beds of Leobersdorf, Austria.

GASTROCOPTA GEMINIDENS (Pils.). Vol. 24, p. 228; vol. 27, p. 202.

A new section, *Geminidens* Pilsbry, 1930, was proposed for *Gastrocopta geminidens* (Pils.) in Proc. A. N. S. Phila, 1930, p. 351 (Dec. 13). It is characterized by the microscopically granulose surface of the conic shell of few whorls, and apertural dentition of *Gastrocopta,* the palatal folds not immersed.

GASTROCOPTA PILSBRYANA (Sterki). Vol. 24, p. 36.

Pupilla stoneri Chamberlin and Jones (Bull. Univ. Utah, xix, No. 4, June, 1929, A Descriptive Catalog of the Mollusca of Utah, p. 83, fig. 32), of which I have examined the holotype (Pl. 15, fig. 3) through the courtesy of Professor Chamberlin, is in all respects a typical *G. pilsbryana.* The type is a fresh specimen, spermaceti-whitish, showing the pinkish dried animal faintly through the shell. It measures 1.7 mm. long, 0.8 wide above the aperture; 5 whorls. It is from Cedar Canyon about 10 miles from the mouth, east of Cedar City, Utah.

The pale color of this specimen is not due to weathering, as supposed to the authors, but is proper to the species. The " fourth fold, back of the parietal tooth " which they mention, was evidently an effect of light, as there is no tooth in that position.

The several forms described as paratypes by Chamberlin and Jones are partly not conspecific. One sent me is *Vertigo coloradensis arizonensis* P. & V. (No. 150656 A. N. S. P.).

GASTROCOPTA PAZI (Hidalgo). Pl. 18, fig. 1.

Vol. 24, p. 102. The localities "Guayaquil" and "Panamá" are to be deleted. Also delete the phrase in the description "or joined at the base and appearing like a bifid tooth".

Florentino Azpeitia Moros has discussed this species fully in Revista Real Acad. de Ciencias de Madrid, vol. 22, 1925, p. 177-180, and has given a figure (p. 178, fig. 8) of an Amancaez (Ecuador) topotype, which is reproduced in our Pl. 18, fig. 1.

It appears that *G. wolfii* and perhaps other forms of the *servilis* group have been confused with the true *G. pazi,* which appears to belong near *G. barbadensis.* I have not seen this species.

GASTROCOPTA DUNCANA, new species. Pl. 17, figs. 1, 2.

The oblong shell tapers slowly from the last whorl to the obtuse apex, the lateral outlines being convex, the diameter nearly equal at the last two whorls. Color translucent cinnamon, the aperture tawny. Surface glossy, very weakly, finely marked with growth lines. The whorls are moderately convex, the last without wave or crest behind the outer lip. The aperture is shortly oval. Peristome reflected, strongly thickened within, the outer lip becoming narrower above, as usual; the terminations of lip are connected by a rather short, somewhat heavy parietal callus, thin at the edge. Three or four teeth, as follows: *angulo-parietal lamella strong, simple and straight.* Columellar lamella rather strong, horizontal; lower palatal fold rather strong, entering, the upper-palatal minute and tubercular (often wanting). The summits of the teeth are whitish.

Length 2.75 mm., diam. above aperture 1.2 mm.; 5½ whorls.

Galapagos: Duncan Island, on the south side, from about 500 feet to near the summit (Pinchot Exped.) Type 152689 A. N. S. P., coll. by Pilsbry and Cleaves, 1929.

This species differs conspicuously from other Galapagos gastrocopts by the simple, completely concrescent, angular and parietal lamellæ, the absence of a basal fold, and the small size or absence of the upper-palatal fold. It has some resemblance to the North American *G. quadridens* in teeth. There is sometimes a very slight median depression in the crest of the angulo-parietal lamella where the two elements meet, but others do not show this.

All of the living examples were partly covered with an irregular incrustation of black dirt, differing from *G. munita* and *G. clausa,* which are generally clean. The seventeen specimens found were picked out of lots of *G. clausa,* of which

there were over 1000 examples. *G. duncana* was much more abundant at the summit of the island than lower down, but it was found also in the lowest lot taken, at about 500 feet.

Nine of the specimens have no upper-palatal fold, though apparently fully adult. This is a very distinct species.

GASTROCOPTA MUNITA (Reibisch). Pl. 17, figs. 3-9.

Vol. 24, pp. 96, 357. Originally described from Albemarle, among bushes near the seashore (Th. Wolf), it was taken by Ochsner near Tagus Cove and near Iguana Cove; on Narborough at 50 feet; Charles Island at 750 feet, and on Tower Island. The Pinchot Expedition obtained it at Chatham Island, from Wreck Bay to the lower edge of the grassy zone. Charles Island at Black Beach, a mile inland. Barrington Island. Daphne Island, near Indefatigable. Albemarle Island in numerous places on the road from Villamil to San Tomas, at a low elevation, and at Tagus Cove. Tower Island around Darwin Bay. Often found in great abundance, in some places associated with *G. clausa*. Several thousand specimens collected by Pilsbry, 1929.

This a variable species, in which extreme forms might be considered distinct if there were not so many transitional examples. There are three main forms:

1. Corneous, ovate, typically with an interpalatal fold and a subcolumellar callus; about 2.4 x 1.2 mm. Typical *G. munita* (Pl. 17, figs. 7, 8, 9).

2. Brown, subcylindric, often lacking an interpalatal fold and subcolumellar callus; length 2.4 to 3 mm. Forma *brunnea*, n.f.; chiefly from Kicker's Rock, Daphne Island and Tagus Cove, Albemarle (figs. 3-6).

3. Brownish, subcylindric, sometimes lacking an interpalatal fold and subcolumellar callus; *small*, length 2 to 2.2 mm.

Albemarle Island.—On the lava plain back of Villamil and along the trail inland to San Tomas, only the typical form of *munita* was found, the shell stout, ovate, corneous, with white aperture (Pl. 17, figs. 7-9; length 2.4, diam. 1.2 mm). This is rather more likely to be the type locality than Tagus Cove, as the latter is a rather out-of-the-way place.

In a low, moist spot on the trail behind Villamil, a place not covered by the last lava flow, brownish, partly more cylindric shells were found, one of the smallest measuring 2.15x0.95 mm.

At Tagus Cove, Albemarle, I found "corneous", that is, pale buffy gray examples (the typical color), of stout contour with a white lip, such as I figured, vol. 24, pl. 19, fig. 1 (figure too brown in the colored copies), together with more cylindric, corneous and decidedly cylindric brown examples, all living together. While a majority of the examples can be assorted into two groups by color and shape, many intermediate shells occur, so that the distinction of "*Pupilla reibischi*" Dall appears to me impracticable. The data upon this supposed species are given below.

Pupilla reibischi Dall, 1928, not 1917.—" Shell subcylindric, blunt, five-whorled, of a dark brown color, whorls moderately inflated, suture distinct; aperture with a wide reflected margin which in well developed individuals is often of a reddish color; pillar lip reflected over a well marked umbilical chink; teeth after Sterki's dental formula but substituting figures for dots after his numeration: A B 3 D 4 5. The parietal tooth (A) when fully developed is bifid anteriorly and somewhat produced behind into the whorl; the other teeth appear short, and none of them are white. Length of shell 2.5 mm.; diameter 1.0 mm. (*Dall*).

" This species is easily distinguished from both *P. munita* and *P. clausa* by its darker color. It is more slender and cylindrical than the former and larger than the latter. It has been submitted to Dr. Sterki who pronounces it distinct from *munita*. The accessory lamellæ are rather deeply ensconced in the aperture. The species seems to be considerably rarer than *P. munita*. *P. clausa*, by the results of collections made, is rare " (*Dall*).

Galapagos: Albemarle Island, near Tagus Cove, under rotten wood at a height of 250 to 300 feet, mixed with *P. munita* (W. H. Ochsner).

Pupilla (*Gastrocopta*) *reibischi* Dall, in Dall and Ochsner, Proc. California Acad. Sci. (4), XVII, June 22, 1928, p. 174. Not *Pupilla reibischi* Dall, Proc. Biol. Soc. Washington XXX, 1917, p. 10; *cf.* Pilsbry, Man. of Conch. XXIV, 1918, p. 357.

The tooth formula (A B 3 D 4 5) used in the above description calls for the following teeth: parietal lamella, columellar

lamella; infrapalatal, lower palatal, interpalatal and supra-palatal folds. This cannot be correct; he apparently means that there is a well united but bifid angulo-parietal lamella, a columellar lamella, basal, upper and lower palatal and interpalatal folds; or according to Sterki's formula (Proc. U. S. Nat. Mus. 1888, pl. 42, fig. 5) he should have written 1 A B C D 4 E.

I have already (1918), explained that Dall's original *Pupilla reibischi* of 1917 was based upon an error; *it was not described,* but the new name was proposed for "*Pupa wolfii*" as figured by Reibisch. This being the case, the name becomes a synonym of *P. wolfii.* The type of *P. reibischi* Dall, 1917, is the specimen figured by Reibisch on his plate 2, fig. 11, Abhandl. Nat. Ges. Isis, 1892 (see Man. Conch. XXIV, pp. 95, 357), which appears to be what Dall referred to in his original proposition of the name. This figure represents the Ecuadorian *G. wolfii,* which is hardly distinguishable from *G. servilis* (Gld.).

The Dall and Ochsner paper of 1928 was published after the death of both authors, and was thus not subject to their final revision.

One of the original lot of *reibischi,* 1928, kindly given me by Dr. Dall, is figured, pl. 17, figs. 5, 6. Length 2.4 mm., diam. 1 mm. The color is between cinnamon and cinnamon-brown on the last whorl, paler above, the lip and teeth light russet vinaceous. The teeth represented are: a bifid angulo-parietal lamella, a strong, simple and horizontal columellar, and upper and lower palatal and basal folds. This specimen has no interpalatal fold, such as Dall described; but this small fold is often lacking in *P. munita.* There is no swelling or crest behind the outer lip. In any large lot of *G. munita* this crest may be either present, weak or wanting.

I collected many specimens at Tagus Cove in 1929, the lot including typical *G. munita* distinguished by its lighter corneous (brownish or buffy gray) color, and the presence of an infraparietal nodule and more or less callus under the columellar lamella. With them are darker, more cylindric shells referable to the present race; but there are specimens of

intermediate character, making a division arbitrary. All were taken at one spot on the rim of the crater, directly inland from the head of Tagus Cove.

Tower Island shells are rather small, 2.3 to 2.6 mm. long. They are rather cylindric, the color corneous to light brown.

In the crater of Daphne Island, north of Indefatigable, both brown and corneous forms occur. The shape is rather cylindric. The infraparietal tubercle and the interpalatal fold are often absent: 2.95 x 1.25 mm. Others are smaller, 2.6 x 1.15 mm.

On Kicker's Rock, off Chatham Island (Pl. 17, figs. 3, 4, forma *brunnea*) the shells resemble those of Daphne, reaching a large size, up to length 3, diam. 1.2 mm., 5½ whorls. The form is subcylindric and the color brown. The infraparietal tubercle is lacking and the interpalatal fold often absent. These two islands are arid breeding places of sea birds, blue-footed boobies on Daphne, man-o'-war birds on Kicker's Rock. The station of corneous and brown *Gastrocopta* on the crater rim at Tagus Cove is similarly arid and dusty.

Small or very small brown shells with the apertural characters of *munita* have been noticed from a moist spot back of Villamil, Albemarle. They also occur on Chatham Island, where there seem to be transitions to small cylindric forms of *clausa,* as noticed under that species.

GASTROCOPTA CLAUSA (Reibisch). Pl. 17, figs. 10-19.

Vol. 24, p. 99. This species is not distinguishable from *G. munita* by any characters of shape, size or color, all being variable in both species. The number of teeth also varies somewhat, but I have found the only really distinctive character to be the presence of a *well developed subcolumellar tooth* in *G. clausa. G. munita* has merely a sloping callus below the columellar lamella, sometimes *very weakly* tubercular, or there is none. In typical *G. clausa* there is a nodule peripherad of the inner end of the parietal lamella (Pl. 17, fig. 12) not present in *G. munita.*

Typically developed specimens of each, such as I figured in

Man. Conch. vol. 24, pl. 19, figs. 1-3 (*munita*) and figs. 12-14 (*clausa*), are very readily distinguishable.

Distribution: Originally described from Indefatigable Island (Theodor Wolf), it was taken on Abingdon by Snodgrass. During the Pinchot Expedition I found it on Chatham, from near shore around Wreck Bay to the lower limit of the grassy zone on the road to Progreso. Charles Island at Post-office Bay and Black Beach. Barrington Island. Indefatigable Island at Academy Bay, Seymour Bay and Conway Bay. Duncan Island, from about 500 feet to the summit. Albemarle Island inland from Villamil. The localities are all in the arid zone, except on Chatham and Duncan where it extends to the lower edge of the humid region. It is a very abundant species near shore, around the roots of shrubs and among rocks.

In many lots there are two main forms: a larger, about 2.6 x 1.3 mm., 5 whorls, ovate-conic, the color very light brown, aperture white (Pl. 17, fig. 10); and a smaller form, about 2.1 x 1.0 mm., 4¾ whorls, cylindric, of a darker color, between cinnamon and cinnamon-brown, the aperture colored (Pl. 17, fig. 11). These forms agree in teeth and in having a low crest behind the outer lip. There are some intergrading specimens in both shape and color of shell and aperture; albino individuals of both forms occur. Those figured are from an aa ridge on the trail between Villamil and San Tomas, Albemarle, in the arid zone.

At Academy Bay, Indefatigable Island, small and large forms measure: 2.2 x 1.1 mm. and 2 x 0.95 mm.

Duncan Island at about 500 feet on the southern side: 2.6 x 1.15 mm., 2.2 x 1.15 mm. and 2.2 x 0.95 mm. (Pl. 17, figs. 16, 17, 19).

In the most fully developed examples of *G. clausa* there are no less than eleven teeth (Pl. 17, fig. 18, a mile inland from Black Beach Road). Usually however, there are nine.

On Chatham Island back of Wreck Bay typical *G. clausa* occurs, though the teeth are less strongly developed than in many specimens from islands westward. There are also small brown examples in some of the lots, not often over 2.25

mm. long, and down to 2 x 1.05 mm. (Pl. 17, figs. 13, 14, 15). In these the infracolumellar tubercle varies from well developed to absent, and the interparietal fold is often wanting. I at first tried to divide the lots into two species, *clausa* and *munita,* and it may be that such a division is possible, but I am more inclined to believe the Chatham form a variable, relatively unspecialized population. These small, ill-characterized *clausa* with *munita*-like forms occur together near the shore and also as high as the upper edge of the wooded zone at the border of the grassy zone, on the road to Progreso.

GASTROCOPTA THOMASSETI Pilsbry. Pl. 14, figs. 5, 6.

The shell is rimate, thin, cylindric-oblong, the last two whorls almost equal in diameter, those above tapering to a very obtuse summit; pale brown fading to nearly white near the summit, composed of *extremely convex* whorls, the first two microscopically granulose, narrow riblets beginning then very weakly, on the last two whorls becoming conspicuous, rather widely, unevenly spaced, some ripples between them. There is no crest or ridge behind the outer lip. The aperture is somewhat squarish with rounded angles and a semicircular basal outline, the peristome thin, expanded. The angulo-parietal lamella is more or less distinctly bilobed in a front view, there being usually a slight depression between the summits of the angular and parietal elements. The columellar lamella is rather strong, subhorizontal. The lower-palatal fold is moderately elongate. No other folds are present typically, but in one example a very small upper palatal nodule is developed.

Length 2.15, diam. above aperture 0.95 mm.; 5 whorls.

Length 2.25, diam. above aperture 1.05 mm.; 5 whorls.

Kopje on Block Island, Weenen, Natal. Type No. 145474 ANSP., paratypes in South African Museum. Collected by Mr. H. P. Thomasset, 1923-1926.

Gastrocopta thomasseti PILSBRY, Ann. Natal Museum VI, part 2, p. 301, pl. 20, f. 5, 6.

This species belongs to the little group comprising *Gastrocopta klunzingeri* (Jickeli), var. *senegalensis* (v. Maltzan)

and *G. hermosa* (Jousscaume) from the northern part of the Ethiopian Region in Abyssinia, Eritrea, Senegal, and British East Africa. The discovery of a closely related form in Natal extends the range of this group of gastrocopts, which is characterized by the great convexity of the whorls. It probably occurs in places all over the Ethiopian Region.

Pupa klunzingeri var. *senegalensis* von Maltzan appears to agree rather closely with *G. thomasseti* except perhaps in the sculpture, which is described as more densely and delicately costulate than *G. klunzingeri.* It has not been figured, and I have not seen specimens. Moreover, the name of that Senegal form is preoccupied by *Pupa senegalensis* Morelet. *G. klunzingeri* of Abyssinia and the Kenya Colony tapers more rapidly than *G. thomasseti,* the last whorl being wider, the costulation is slightly stronger and more regular, and both upper-palatal and basal folds are developed. In the specimens of *G. thomasseti* seen, a very small upper-palatal fold was noticed in one only.

While the summit of the angulo-parietal lamella is generally distinctly bilobed, as in the figured type, there are a few examples in which it is level, the angular and parietal components being more completely united.

GASTROCOPTA DAHLI Thiele. Pl. 18, fig. 2.

Two colorless shells from Ralum are rather cylindric, with weakly, obliquely striate, convex whorls. Apex rather obtuse. The upper whorls increase distinctly; the penult is about as wide as the last but not so high. The aperture is rather small; a parietal lamella is bifid, its outer part passes in a curve into the outer lip; in the right side there is a tooth some distance from the margin, and a second, somewhat longer, where the outer passes into the basal margin. On the columella a denticle on the lower part of a more inwardly placed thickening is visible. The peristome is widened but not expanded; the umbilical fissure is hardly perforated. Height 2.25, diam. 1.1 mm. (*Thiele*).

Bismarck Archipelago: Ralum (Dahl).

Gastrocopta dahli Thiele, Zoologische Jahrbucher, Abth. f. Syst. etc., Bd. 55, p. 124, pl. 5, figs. 8, 8*a*. 1928.

Gastrocopta semiclausa Thiele. Pl. 18, fig. 3.

Two shells, also from Ralum, differ from the preceding species by the somewhat larger and more ventricose shell with the same number of whorls, and especially by the dentition of the aperture. This has on the right side 3 teeth, a small denticle near the parietal lamella and a rather broad, lamelliform projection of the columella obliquely in the interior of the terminal part of the last whorl. Height 2.6, diam. 1.2 mm. (*Thiele*).

Bismarck Archipelago: Ralum (Dahl).

Gastrocopta semiclausa Thiele, Zoologische Jahrbücher, Abth. f. Syst. etc., Bd. 55, 1928, p. 125, pl. 5, figs. 9, 9*a*.

Belongs in the kindred of *G. macdonelli* (Brazier), from which it may be considered specifically distinct (*Thiele*).

GYLIOTRACHELA Tomlin.

Gyliauchen Pilsbry, Manual Vol. 24, p. 174, 210, 1917. Not of Nicoll, 1915.—*Gyliotrachea* Tomlin, Proc. Malac. Soc., Lond., Vol. 19, March, 1930, p. 24.

FAUXULUS (Vol. 24, p. 234).

Fauxulus burnupianus Pilsbry. Pl. 14, figs. 1, 1*a* (type), 2, 3.

The shell resembles *F. capensis* in form, being cylindric with a shortly conic summit, sinistral, with a deep, comma-shaped umbilicus; thin; opaque whitish with a faint pink tint and some sparsely scattered purplish-brown dots and small spots. The surface has but little gloss, and is closely sculptured with fine, rather sharp, curved striae, somewhat weaker on the last whorl and wanting on the first 1½ whorls, which are slightly roughened by a close, superficial, somewhat uneven microscopic pitting. The early whorls are convex; later ones are slightly convex, the last whorl compressed and tapering

downwards, forming a narrowly rounded base; it ascends to the aperture and is somewhat excavated within the umbilicus, which becomes a mere perforation beyond the last whorl.

The aperture is shaped like that of *F. capensis,* ochraceous within, and has three lamellæ as in that species. The angular lamella is rather long and a little impressed or sinuate in the middle. Parietal lamella enters deeply. The columellar lamella is strong, horizontal, and enters about a half whorl. There are three folds a short distance within the outer lip: the upper palatal fold is very long, its inner end curving downward; interpalatal fold small (often twinned); lower palatal fold long, its inner end not visible in a directly face (ventral) view. The peristome is white, thin and well expanded, the margins connected by a thin parietal callus.

Length 5.9, diam. above aperture 2.8 mm.; 9½ whorls. Type.

Length 5.2, diam. above aperture 2.9 mm.; 8½ whorls.

Length 5.2, diam. above aperture 2.6 mm.; 9 whorls.

Length 7.1, diam. above aperture 3.1 mm.; 10 whorls.

South Africa: Seal Rock, opposite Dyer Island, Cape Province. Type 144264 ANSP., collected by Herbert Lang.

Fauxulus burnupianus Pilsbry, Nautilus, vol. 41, Jan., 1928, p. 108; Ann. Natal Museum VI, part 2, 1929, p. 300, pl. 20, f. 1-3.

This snail has the shape, texture and color of *F. capensis* (Kstr.), and is about the size of the small race of that species from Port Elizabeth. It differs by the larger apertural lamellæ and folds, which have more the form of those teeth in *F. pamphorodon* (Bens.), the upper-palatal fold being laminar, entering deeply and descending, and the lower-palatal is prolonged inward.

The shell is whitish to the eye but under a lens is seen to be delicately tinted pink or bluish, variously but sparsely maculate, and sometimes having an ochraceous band below the suture, such as occurs in certain shells of *F. capensis.* Of the 18 examples seen, only one exceeds 6 mm. in length.

This species was found with specimens of *F. capensis* 7 to

9 mm. long, and *F. layardi*. It is named in honor of the late Mr. H. C. Burnup, author of several excellent papers on South African snails.

Subgenus *Anisoloma* Ancey.

FAUXULUS FALCONIANUS Pilsbry. Pl. 14, figs. 4, 4*a*.

The shell has a small perforation and long rimation, is ovate-conic, tapering from the last whorl, the spire attenuate above, where the outlines are lightly concave; base compressed in its last half. The color is light cinnamon, paler at the summit. The first two whorls are strongly convex and smooth; following whorls are nearly flat, with sculpture of delicate oblique striae closely placed but much narrower than their intervals and bending forward as they approach the suture below. On the penult whorl the striae are coarser and more strongly curved forward near the anterior suture. The last whorl has less oblique riblets nearly as wide as their intervals. The aperture is somewhat triangular, there being an impression or bay in the middle of the left margin, which projects in a semicircle above it. The microscope shows a dense, irregular papillation over the interior of the aperture as well as upon the thin parietal callus covering the riblets above it. The angular and parietal lamellæ are about equal in height, the former emerging to the outer lip near its insertion. Columellar and supracolumellar lamellæ about equal, long, emerging to the edge of the columellar lip. Infracolumellar lamella represented by a small nodule (or in other specimens, absent). Basal fold small, short, receding. Lower-palatal fold is sinuous, emerges to the lip-edge and enters deeply. The upper-palatal fold is long but much shorter than the lower, towards which it converges inwardly. The suprapalatal fold is short but in front view about as prominent as the upper-palatal fold.

Length 4.4 mm., diam. 2.6 mm.; 9 whorls. Type.

Length 4.5 mm., diam. 2.6 mm. Paratype.

Natal: Zimbaba Bush, Krantzkop, collected by W. Falcon, 1923. Type No. 145477 ANSP., cotype in coll. Natal Museum.

Fauxulus falconianus Pils., Ann. Natal Museum VI, May, 1929, p. 299, pl. 20, f. 4, 4*a*.

By its attenuate spire this species resembles *Fauxulus pereximius* (Melvill and Ponsonby), but that is a far larger shell, said to be 7 mm. long. The figure given by Melvill and Ponsonby is not sufficiently exact to admit of any comparison of the teeth; if it is to be trusted their species must be quite unlike *F. falconianus* in the shape of the outer lip. None of the other Fauxuli of the subgenus *Anisoloma* now known have the spire attenuate as in these species.

ABIDA (Vol. 24, p. 262).

Abida variabilis sillarensis (Piersanti). Pl. 18, figs. 5, 6, 7.

Shell brown or cinereous, alabastrine, elongate, cylindric, not swollen in the middle, the peristome expanded, generally aorthic, sometimes with a white epistomatic callus. 10-13 whorls.

Length 11.2 to 14.3 mm., diam. 2.9 to 3.2 mm. (*Piersanti*); 86 per cent of the specimens are from 2.9 to 3 mm. in diameter, and 178 out of 200 are from 11 to 12 mm. long.

Italy: Appenines of the upper Sillaro valley, Prov. Bologna.

Pupa variabilis Drap. v. *sillarensis* Piersanti, Boll. dell'-Istituto Zoologico della R. Univ. di Roma, V, 1927, p. 129-134, figs. 5-7 (fig. 5, variation *orthostoma,* fig. 6, variation *plagiostoma,* p. 134).

A less convex, more cylindric shell than *A. variabilis,* differing also from the cylindric *A. v. polita,* and a descendant of var. *producta,* found by Strobel on the Tidone and the Secchia (northwestward).

The locality of this race is a wind-beaten treeless terrace with southern exposure, at an elevation of about 400 meters, having scant vegetation of Artemesia, broom etc., reached by a mule trail which ascends from a spring of sulphur water on the left bank of the upper Sillaro. There is a fauna of mullusks numerous in individuals but few in species, among them this race of *Abida variabilis.* It lives in families of 20 or 30 individuals on small dry bushes or broom. Even when

they are covered with snow and ice it does not seek refuge by burrowing or under stones. It is capable of fasting an entire year.

Two forms are named: *orthostoma* (Pl. 18, fig. 5), and *plagiostoma* (Pl. 18, fig. 6). These are merely individual variations in the inclination of the axis of the aperture to that of the shell.

Piersanti, from whose paper the above is taken, considers *A. v. sillarensis* a recent immigrant, as it was not mentioned by Tassinari, who collected in the Sillaro valley. It is considered the furthest outpost of one of the two streams of migration of *variabilis* into Italy.

ABIDA PYRENAEARIA (Mich.). Vol. 27, p. 277.

Ninth line from bottom, in place of " pl. 24, figs. 7, 8, 9 " read pl. 24, fig. 10.

Fourth line from bottom, in place of " pl. 24, fig. 10 " read pl. 24, figs. 7, 8, 9.

On p. 328, lines 15-17 from bottom: the names *P. saxicola* M.T. and *P. clausilioides* Boub. were transposed.

ABIDA FRUMENTUM GIGANTEA (Schroeder). Vol. 24, p. 303.

Light horn-colored, the whorls, especially the middle ones, very finely and obliquely striate transversely. 15-17 mm. long, 4-5 mm. thick, with 12-13 whorls. (*Schroeder*).

Italy: Salo in Monte S. Bartolomeo, Lake Garda, also at Gargnano.

Pupa (*Torquilla* Stud.) *frumentum* Drap., var. *gigantea* SCHROEDER, Beiträge zur Konchylienkunde von Tirol und italienischen Grenzgebieten, 1910, p. 40.

The name is preoccupied by Moquin-Tandon, see Vol. 25, p. 32; but Schroeder's form need not be renamed until its status can be investigated anew.

GRANOPUPA (Vol. 24, p. 332).

GRANOPUPA MARMOUCHANA (Pallary). Pl. 18, fig. 4.

Shell elongate, conic, of a deep brown tint, provided with an umbilical crevice. Spire acuminate, tapering, terminating

in a smooth, glossy protoconch, 9 convex whorls of regular increase, separated by a not very deep suture, and regularly sculptured with fine striae oblique from left to right, the closeness of the striae emphasized on the lower whorls. Penult whorl well rounded, last whorl ascending a little to the insertion. Aperture very little oblique, a little reflected at the outer margin, with two oblique internal lamellæ which do not reach the outer margin. Columella vertical, well rounded at base and ornamented with a small denticle (angular lamella) on its upper part. Finally the parietal wall carries two internal folds of which the upper (parietal) is more prominent than the median; these two lamellæ opposite the two palatal lamellæ (*Pallary*).

Length 7, greatest diam. 2¼, smaller diam. 2 mm.

Morocco: Talzent, in the gorges of Meskedal and Arourirt on cliffs of Jurassic limestone.

Pupa marmouchana Pallary, Journ. de Conchyl., vol. 72, August, 1928, p. 13, fig. B.

This species seems to be near *Pupa rhodia* Roth of Syria, but our form has less convex whorls and the size is smaller. No North African species is comparable (*Pallary*).

Granopupa granum (Drap.). Vol. 24, p. 335.

Pallary (Mem. l'Inst. d'Egypte XI, 1926, p. 40) thinks that *Pupa lamarckii* Aud. (Vol. 26, p. 238) is a repaired *Granopupa granum*.

CHONDRINA (Vol. 25, p. 1).

Chondrina avenacea (Brug). Vol. 25, p. 10.

Var. *elongata* Stossich. Form long cylindric, of 8 whorls. Ospo, territory of Trieste. (*Torquilla avenacea* var. *elongata* A. Stossich, Boll. Soc. Adriatica di Sci. Nat. in Trieste, vol. 19, 1899, p. 32).

Paul Ehrmann (Archiv f. Molluskenkunde, vol. 63, pp. 1-28) believes that two species are commonly comprised under the name *avenacea*. The true *Pupa avenacea* he believes to be identical with *P. cereana* ("Mühlfeld" Küster). For

the other species, usually known as *avenacea,* he uses the name *clienta* Westerlund, contrasting them thus.

C. avenacea (Brug.)	*C. clienta* (West.)
1. Shell surface irregularly striate.	1. Shell regularly, finely striate.
2. Both principal palatals and the infrapalatal almost equally strong, the parietal and columellar lamellæ placed opposite them.	2. Only the two principal palatals strongly developed; super- and infra-palatals, if present, very short and receding.
3. Only the upper whorls strongly convex, the middle and lower laterally compressed.	3. Middle and lower whorls are also quite convex.
4. Last whorl usually strongly flattened or even impressed below the shoulder-like swelling behind the aperture.	4. Last whorl flatly convex, but little flattened.
5. Peristome little expanded, weakly lipped, light brownish; interior of aperture more or less reddish brown.	5. Peristome distinctly expanded, lipped, whitish; interior light grayish brown.
6. Color of shell usually lighter or darker reddish brown.	6. Color of shell usually corneous brown.

In distribution, according to Ehrmann, *avenacea* is mainly western, from the Maritime Alps through the Swiss and French Alps to the Alpenrhein. *C. clienta* is mainly east, as far as the Caucasus, where a new race which is called [CHONDRINA CLIENTA] CAUCASICA Ehrmann occurs (l.c. p. 19, footnote 1, pl. 1, fig. 4). It differs from the type by the more elongate form, less regular striation, and an infrapalatal, which is often stronger than the supra-palatal (Pl. 20, fig. 4). Type locality Letschghum, Caucasus. Unfortunately the var. *subcereana* West. of the western Crimea could not be compared.

While I do not question the zoological observations involved in this discussion, I may venture to suggest that the nomenclatorial questions require further examination. Bruguière and Geoffroy, whom he quotes, dealt with shells *from the environs of Paris.* It is not at all certain that Draparnaud, far to the south in Montpellier, had the same form. Paris specimens, which I do not possess, are required in order to determine just what the typical *P. avenacea* is. Also, the long list of synonyms and varieties must be gone through to determine whether there is an earlier name for the species Ehrmann has segregated as *Ch. clienta.*

PUPOIDES (Vol. 36, p. 108).

The genotype, *P. nitidulus,* was first designated by Kobelt, 1880: Illustr. Conchylienbuch, p. 267.

Add to synonyms: *Themapupa* Iredale, The Victorian Naturalist vol. 47, Nov. 1930, p. 120, mt. *Pupa beltiana* Tate.

Mr. Iredale states that " it has no real relationship " with *Pupoides,* but he does not attempt to mention any differential character in the half page treating of *"Themapupa" beltiana.* Until such characters are indicated, there seems little reason to regard *Themapupa* seriously.

Pupoides marginatus (Say). Vol. 26, p. 111.

A sinistral specimen was found by Dr. Julia Gardner of the U. S. Geol. Survey in Texas, on the Colorado River, 1½ miles below the Travis-Bastrop Co. line.

Pupoides karachiensis Peile. Pl. 18, fig. 8.

The shell is subperforate with six very convex whorls, apex rather flat. Color (evidently faded) whitish buff. Growth lines faint on spire but a little stronger on back of body whorl. Aperture sub-circular, labrum expanded but not reflexed. Parietal denticle weak. Length 4.5 mm. Diameter of penultimate whorl, above aperture, 1.5 mm. Length of my smallest specimen, 4.1 mm.; diameter, 1.4 mm. The shell somewhat resembles *P. bryantwalkeri* Pilsbry, but has more convex whorls and more rounded aperture (*Peile*).

India: Karachi (Godwin-Austen and Peile).

Pupoides karachiensis Peile, Proc. Malac. Soc., London, vol. 18, p. 139, fig.; March, 1929.

"Among the undescribed material in the collection of the late Col. H. H. Godwin-Austen, now in the British Museum, was found a single specimen labelled '*Buliminus*, sp. nov. Karachi'. The shell agrees with half a dozen specimens in my own collection which were found in sand from the Karachi beach in company with *P. coenopictus*, Hutton, and a multitude of interesting small marine shells. The Museum specimen has been selected as the type."

Pupoides hoggarensis (Pallary).

Shell elongate, of very convex whorls with very fine striae, visible only under a lens, 6½ swollen whorls separated by a slightly oblique suture, of very regular increase; the last whorl a little descending. Aperture very little oblique, with the outer margin very little reflected. Aperture oval, produced to the right, with the outer margins subparallel and rounded at the lower part. Umbilicus narrow. Height 4.5 to 4.75 mm., greatest diameter 2 mm. (*Pallary*).

Hoggar: Tihaliouine at 2150 meters; Imegha; Tiniker (Tifidest) up the Aguelman.

Leucochiloides hoggarensis Pallary, Bull. Soc. d'Hist. Nat. de l'Afrique du Nord, vol. 20, 1929, p. 6.

This species differs from *L. senaaricus* by the more slender contour, the whorls more convex and especially by its aperture produced towards the right. The little denticle which appears at the junction of the outer lip in *L. senaaricus* is wanting in our species (*Pallary*).

Pfeiffer called his species *sennaariensis*, not *senaaricus*.

PUPILLA (Vol. 26, p. 152).

Mr. B. B. Woodward has called attention to the first publication of the name *Pupilla* Leach MS. It was in Fleming: British Animals, 1828, p. 268. The name occurs in the text under *Pupa marginata* Drap. thus: "This species was sent

me many years ago by Dr. Leach, from Battersea, under the title of *Pupilla marginata.*"

PUPILLA OERSTEDII (Mörch).

Shell umbilicate, cylindric, obliquely striatulate, glossy, brown. Whorls 6½, convex, with impressed suture, the last equal to one-fourth the length. Peristome thickened subreflected. Aperture triangular, the columella wide, entering, provided with a punctiform white tooth; parietal tooth subcompressed; lips joined by a funicular callus. Length 3.5 mm., diam. 2 mm. (*Moerch*).

Nicaragua (A. S. Oersted).

Pupa (*Pupilla*) *oerstedii* MOERCH, Malak. Bl. VI, 1859, p. 111.—PFR., Monogr. VI, p. 306.

This species comes from further south than any other American *Pupilla,* if it belongs to that genus. It is known by the original account only. Moerch notes that "The outer lip has two or three notches which give the aperture an angular appearance. The parietal tooth is somewhat removed from the curving lip-margin, and equally removed from the funicular callus. Epidermis is weathered on the oldest whorls. The habitus and color are quite as in our European species, such as *Pupa dolium, muscorum* etc."

PUPILLA STERKIANA (Pilsbry). Vol. 26, p. 156.

Add the locality: San Martin Island, Lower California (G. D. Hanna). A few beautiful albino shells were among many of the normal brown color (*Pilsbry,* Proc. Cal. Acad. Sci. (4), vol. 16, 1927, p. 186).

PUPILLA GONIODON Pilsbry. Pl. 15, fig. 12.

The shell resembles *P. sterkiana* of the Lower Californian mainland in shape and sculpture. It is thin, cylindric, with blunt, rounded ends, cinnamon-colored, with sculpture of strongly retractive, widely spaced riblets, which are more or less irregular or in places dislocated, sometimes with short, twig-like branches; they are about one-fourth as wide as their intervals or less. The initial 1½ whorls have irregularly an-

astomosing net-like sculpture and pale grayish color. Subsequent whorls are moderately convex, and the last one rises somewhat and becomes flattened laterally towards the aperture. The aperture is about as wide as long, somewhat squarish with rounded angles. The peristome is expanded, the outer and basal margins thickened with a cinnamon callus within, upper external margin thin; columellar margin dilated. There is a transverse white nodule on the parietal wall within the angle of the lip, united with the latter, and continued in a thin callus across to the columellar lip-insertion. Length, 4 mm.; diam., 1.9 mm.; 6¾ whorls.

Guadalupe Island, Lower California, at Northeast Anchorage at an elevation not greater than 100 ft., in the canyon back of the buildings, abundant (G. D. Hanna).

Pupilla goniodon Pils., Proc. Cal. Acad. Sci. (4), XVI, 1927, p. 172, pl. 7, fig. 3.

The presence of a strong angular nodule and the more delicate riblets differentiate this species from *P. sterkiana*. In exceptional specimens there is the barely perceptible trace of a parietal tooth, rather deep within; in none do I see any columellar tooth or truncation, such as *P. sterkiana* usually shows in an oblique view in the aperture. The species was collected alive in some numbers.

Pupilla guadalupensis Pilsbry. Pl. 15, figs. 10, 11.

Shell cylindroid, slowly tapering in the upper half, cinnamon colored, only slightly glossy, very evenly sculptured with retractive riblets paler than the ground color, from a half to a third as wide as their intervals and about 14 to 16 in one millimeter on the face of the last and penult whorls; the usually paler 1½ embryonic whorls have the net-pitted sculpture of Striopupilla. Subsequent whorls are rather strongly convex. Aperture rounded below, straightened with rounded angles above; no trace of a crest or contraction behind outer lip. Peristome expanded, heavily thickened within except at the posterior-lateral curve, continuous in a slightly free or adnate callus across the parietal wall. Aperture typically four-

toothed: angular lamella in form of a callous pad within the posterior angle, parietal lamella short, stout, deeply placed, columellar lamella low and broad, palatal fold a rounded, deeply placed tubercle. (Other forms of the species may lack all but the angular pad.)

Length 2.8 mm.; diam. 1.5 mm., 5½ whorls. (Holotype.)

Length 3.1 mm., diam. 1.5 mm.; 5¾ whorls.

Guadalupe Island, Lower California, 1000 ft. above Northeast Anchorage; also from 2 miles north of south end, on the east side, near sea level at N-E. Anchorage and on the crest of Pine Ridge at an elevation of 3000 ft. (G. D. Hanna).

Pupilla guadalupensis Pilsbry, Proc. Cal. Acad. Sci. (4), XVI, 1927, p. 173, pl. 7, f. 1, 2.

The close, regular, evenly developed ribs distinguish this species from other American Pupillæ, the other two species of the subgenus Striopupilla having the ribs more uneven and more widely spaced. It resembles the Asiatic *Pupilla annandalei,* which, however, belongs to a different subgenus.

As in most species of this genus, the parietal, columellar and especially the palatal teeth are variable, either present or absent. The angular pad appears in all adult individuals, and is sometimes the only tooth present, as in fig. 11. The four-toothed form, selected as typical on account of its status as the most primitive form, is exceptional in some lots seen, but common in other lots.

Five specimens taken at random from the type lot have teeth as follows:

1. Angular, parietal, columellar, palatal.
2. Angular, parietal, columellar, palatal.
3. Angular, parietal, ...
4. Angular, ... columellar, ...
5. Angular, ...

In No. 2 the parietal is very small; in No. 4 the columellar can be seen only in an oblique view in the aperture.

A similarly unselected lot of ten, from two miles north of the south end of the island, has teeth as follows:

1. Angular, parietal, columellar, palatal.
2. Angular, parietal, columellar, palatal.
3. Angular, parietal, columellar, palatal.
4. Angular, ... columellar, palatal.
5. Angular, parietal, columellar, ...
6. Angular, parietal, columellar, ...
7. Angular, parietal, columellar, ...
8. Angular, parietal, ... palatal.
9. Angular, parietal, ...
10. Angular, ...

PUPILLA CUPA (Jan). Vol. 26, p. 185.

The type of *Vertigo eumicra* Bourguignat (Vol. 26, p. 233) from near Lucerne, is stated by G. Mermod (Revue Suisse de Zool. Vol. 33, July, 1926, p. 568) to be a specimen of *Pupilla sterri* Voith (=*cupa*). *Vertigo eumicra* Clessin is considered by Mermod to be a toothless *V. arctica* Wallenb.

On page 188 of Vol. 26 the first two paragraphs should follow the account of *P. cupa turcmenia*. They were accidentally transposed.

PUPILLA TRIPLICATA (Stud.). Vol. 26, p. 189.

Rosen (Mittheil. Kaukasischen Museums VI, 1914, p. 192, 193) gives Caucasus localities for var. *luxurians* Reinh.; var. *inops* Reinh. (*cylindrata* Bttg.), which was placed under *muscorum* in Manual Vol. 26, p. 180, following Boettger, probably a mistake; and var. *subconiformis* Bttg., the latter a pen or typographical error for *suboviformis* Bttg., Jahrb. D. M. Ges. VI, 1879, p. 26; Manual Vol. 26, p. 192 (where Vol. VII of the Jahrbücher is erroneously cited).

PUPILLA SIGNATA (Mouss.). Vol. 26, p. 194.

This species has been reported from Alaska by Westerlund (Vega-Exped. Vetenskap. Iakttagelser, IV, 1887, p. 164) and from the Rocky Mountains by Sterki (Nautilus VI, 1892, p. 3) but both records seem to have been based upon erroneous identifications.

Pupa diecki Gredler (Vol. 26, p. 196) is thought by Lindholm to be identical with *signata* (Ann. Mus. Zool. Acad. Sci. Russ., 1922, p. 309).

Pupilla pupula (Desh.). Vol. 26, p. 214.

Colonel A. J. Peile writes me that he suspects that Deshayes' figures referred to this species were drawn by an artist's error from *Lauria bourbonensis,* not from the specimen Deshayes described. Deshayes himself noticed that his figures imperfectly represented his species. My figures in vol. 26, pl. 17, figs. 12, 13 are the true *P. pupula.*

Pupilla l'eprevieri Pallary. Pl. 18, figs. 10.

Shell turriculate, cylindric, with slightly convex whorls, the summit obtuse. 7½ whorls; suture well marked. Last whorl noticeably ascending to the insertion. Aperture vertical, semicircular. Outer margin doubled by a whitish external crest. Columellar wall ornamented with a very small lamella. Color varying from ashy brown to uniform deep brown (*Pallary*).

Length 3.5 to 4, diam. 1.5 mm.

Morocco: Laghouat, dép. d'Alger. (Messrs de l'Eprevier).

Pupilla l'Eprevieri Pallary, Journ. de Conchyl. vol. 71, March, 1928, p. 245, pl. 3, f. 36-38.

Pallary remarks that this species, common at Laghouat, is perhaps approached by *P. muscorum* and *umbilicata,* but differs by the more numerous whorls in examples of equal size and the more cylindric form. It has much the appearance of the Pleistocene form of *Orcula* of the northern Sahara, from which it scarcely differs except by being of half the size.

Lauria zonata (Bttg.). Vol. 27, p. 79.

Boettger's *Pupa zonata,* 1883, is a homonym of *Pupa zonata* Gassies, 1869, and may be changed to *Lauria albina* Bttg., a name given to a greenish-white mutation. If the usual banded form requires a name it may be called forma *zonifera.*

Lauria wouramboulchiensis Connolly. Pl. 18, fig. 9.

Shell very small, ovate, rimate, rather solid and opaque, which may be due to weathering, glossy, pale brown, with darker oblique stripes on the striae. Spire moderately pro-

duced, sides somewhat convex, apex obtusely rounded. Whorls 5, convex, regularly increasing, first 1½ smooth, next 1½ very closely, microscopically, transversely and slightly obliquely striate in the lines of growth, last 2 sculptured with regular, flattish, somewhat distant, slightly oblique striae, darker than the intervals between them, there being about 12 and 13 visible on the 4th and 5th whorls respectively; suture simple, well defined. Aperture quadrate, rounded at base, peristome glossy-white, expanded and reflexed, outer lip receding only very slightly in profile, columella erect, margin broadly triangularly reflexed, callus thin, but well marked and continuous; the only dental process is an inrunning parietal plait, inclined downwards to the right, three-quarters of the distance from the columella to the outer lip, but there is a slight inflation of the inner margin one-third way down the outer lip and another, inset and hardly noticeable, halfway up the columella. Long. 3.3, lat. 2.1; apert. alt. 1.3, lat. 0.8; last whorl 2.0 mm. (*Connolly*).

Abyssinia: Serpent Lake, Wouramboulchi (Omer-Cooper).

Lauria wouramboulchiensis Connolly, Proc. Zool. Soc. London, 1928, p. 168, pl. 1, f. 6.

"The shell is smoother and squatter than *L. bruguierei* and comparatively wider, while the dark transverse stripes impart to it a very distinctive appearance. I find nothing resembling it closely in the fauna of continental Africa, but from the respective figures it must be closely allied to *L. bourbonicensis* Pilsb. The peristome, however, in the Abyssinian race is white and somewhat broadly reflexed, instead of brown and very narrowly so, as emphasized in the case of *bourbonicensis*, which, too, should have stronger sculpture. It has not been proved hitherto that any of the South or Central African Pupillidae are actually conspecific with those of adjacent lands, and even if *wouramboulchiensis* eventually proves to be merely a variety, it will be entitled to full varietal rank on account of its remarkable striped coloration.

I have not been able to examine the young stage, but it appears hardly likely to belong to a genus other than *Lauria*."

Section SENILAURIA Pilsbry

Petrarca PILS., 1922, Man. Conch. Vol. 27, p. 45, 122, not *Petrarca* Fowler, 1899 (Cirripedia)—*Senilauria* PILS., Nautilus Vol. 41, Jan., 1928, p. 108, tod. *Lauria fasciolata* (Morelet).

AGARDHIA (Vol. 27, p. 129).

AGARDHIA MACRODONTA Hesse. (Vol. 27, p. 156).

Has been figured by Dr. Antoni Wagner in Ann. Zool. Mus. Polonici Hist. Nat. VI, Dec. 1927, p. 306, pl. 15, figs. 115, 116.

A. m. rumelica Hesse, l.c., p. 307, pl. 15, fig. 117.

ORCULA (Vol. 27, p. 1).

Scyphus " Monts." with the type *Pupa doliolum* Brug. was first published, I believe, by Cocconi, 1908, Bol. Mus. Zool. ed Anat. Comp. R. Univ. Torino vol. 23, No. 583, p. 7, footnote. *Scyphus doliolum* var. *singularis* Monts., n. var., is reported from southern Italy and Tremiti Island by Cocconi, *l.c.*, without description.

ORCULA DOLIUM PSEUDOGULARIS Wagner. Pl. 19, fig. 5.

Vol. 27, p. 11. In comparison with the typical form the shell appears more slender and cylindrically drawn out, with weaker growth striae, so that the surface is smoother and glossier. The 9 whorls increase more rapidly and are relatively higher; the last ascends only a little to the aperture. The lip callus is thinner, the upper columellar lamella, though it is often weaker, yet is always present. Height 8, diam. 3-3.4 mm. (*Wagner*).

Orcula dolium pseudogularis A. J. WAGNER, Ann. Zool. Mus. Polonici Hist. Nat. I, 1922, p. 121, pl. 6, fig. 39.

On dry clifs, covered only with shrubs and low plants, at Gleissenfeld (Türkensturz) in the Pittental, and similar places in this valley. Such slim, cylindric forms of *O. dolium* Drap. are to be found sporadically, together with typical examples, in other places, especially at high elevations, as on the Schneeberg by Wiener-Neustadt; but at the Gleissenfeld

locality in the Pittental no typical examples, or at most transitions toward such, are to be found, showing this to be a stable local form by the action of local conditions (*Wagner*).

ORCULA DOLIUM TATRICA Wagner. Pl. 19, fig. 6.

This is the smallest form of *O. dolium* Drap. yet known to me, showing only 7½ whorls, fine growth striae, and in fresh examples a light silky luster. Moreover, the lip-callus is very thin, the lamella on the parietal wall very low, and an upper columellar fold is lacking. Alt. 5, diam. 2 mm. (*Wagner,* Ann. Zool. Mus. Polonici Hist. Nat. I, 1922, p. 121, pl. 6, f. 40).

Collected in the Tatra by Slosarski, without nearer localization; from the occurrence of conspicuously small specimens of *Pirostoma tumida* A. Schm., *P. plicatula* Drap. and *Clausilia orthostoma* Mke. with the same label, a considerable elevation may be presumed.

ORCULA FUCHSI Zimmermann. Pl. 20, figs. 5, 6, 7.

Shell strikingly slender, gradually tapering from the last whorl to the apex, finely and rather regularly striate, dark corneous-brown to reddish brown, somewhat glossy. Umbilicus very narrow, almost punctiform; neck rounded. The 8½ to 9½ whorls increase slowly and regularly, are relatively strongly convex, and separated by a markedly deep suture, the last whorl forming about one-fifth the length of the shell. Aperture semiovate, rather vertical. Columellar margin deviating little from the longitudinal axis of the shell; outer margin nearly parallel to it, only a little produced up on the penult whorl. Peristome distinctly expanded, not thickened; whitish; a palatal callus, showing through outside, is always present; its development is irregular, but in the majority of specimens it is well developed though not so strong as in *O. spoliata* Rossm.; as in this species, advancing towards the interior and thus narrowing the cavity in a vertical view from below; there is no fold-like projection inward. The columellar margin is straight and *without any indication of a fold;* further inward also it is smooth as seen in a broken shell.

The parietal lamella stands midway between columellar and outer lip insertions, and is low and short, ending immediately behind the aperture in the last third of the last whorl.

Length 6.6 mm., width 2.3 mm. (*Zimmermann*).

Austria: at the foot of the so-called "Turmauer," northern spur of the Goeller, at an elevation of about 750 meters, in a botanically well-known subalpine enclave, which here extends from the Goeller nearly into the valley (Arnold Penther; Anton Fuchs). Later found near the first locality on the "Waldhuttsattel", on the road from Kernhof, at the upper limit of the subalpine forest at about 1200 meters.

Orcula fuchsi Zimmermann, Archiv f. Molluskenkunde, vol. 63, p. 44, pl. 4, f. 3-5. Jan. 1, 1931.

At the higher locality it is smaller, 6.3 x 2.2 mm. (Pl. 20, fig. 7). In both places it lives with *O. dolium* and the lower Austrian race of *O. spoliata*, but without intergradation. Figures from Zimmermann.

Orcula gularis pseudodolium Wagner. Pl. 19, figs. 3, 4.

Vol. 27, p. 14. The shell is larger and wider than the typical form, and tapers in an acute cone above; in habitus recalling *O. conica* Rm. and *O. dolium* Drap. As a form of *O. gularis* Rssm. it is characterized by the features of the aperture. Of the two columellar lamellæ, here the upper is also well developed and emerging (weak in the typical form). The palatal callus is strongly developed as in *O. gularis spoliata*, yet with the pliciform appendages characteristic of the type. The peristome is, like that of *O. dolium* Drap., more broadened and expanded. Alt. 7, diam. 3 to 3.5 mm.

Feuchtenauer Alm on the Hochengsengebirge at Windischgarsten, Upper Austria (Wagner, Ann. Zool. Mus. Polonici Hist. Nat. 1, 1922, p. 122, pl. 6, f. 37 *a, b*.

Orcula gularis tolminensis Wagner. Pl. 19, figs. 7, 8.

The shell is smaller throughout than the typical form, with only 7 to 9 whorls, thin lip-callus and conspicuously lower, often obsolete columellar folds, which are not visible in a

direct view in the aperture. The strong palatal callus has excessively developed, very long appendages, which extend as far as over the umbilical slit in the throat. Alt. 5.5 mm., diam. 2.3 mm.

Neighborhood of the waterfall of Perichnik at Tolmein, Isonzo Valley.

Orcula gularis tolminensis A. J. Wagner, Ann. Zool. Mus. Polonici Hist. Nat. I, 1922, p. 122, pl. 6, f. 38 *a, b*.

The excessively long palatal folds in an otherwise weakly developed apertural formation appear remarkable.

Orcula kaznakovi (Rosen). Pl. 19, figs. 1, 2.

Shell with a curved umbilical crevice; ovate-cylindric; smoothish, sculptured with remote, obsolete lamellæ; yellowish, subpellucid. Apex obtuse. Whorls 9½, slowly increasing, the upper 5 a little convex, the rest flat, the last whorl rather rapidly ascending to the aperture, constricted. Aperture truncate-oval, with a compressed, very high and deeply entering parietal lamella, columella within biplicate above. Peristome somewhat dilated, with a white thickening, the margins converging, joined by a lamelliform white callus. Length 8, diam. 5⅝ mm., aperture 2½ mm. high and wide (*Rosen*).

Caucasus: Ardanuch, with *Buliminus florenskii*.

Pupa kaznakovi Rosen, Mittheilungen des Kankasischen Museums VI, 1914, p. 190, pl. 2, figs. 11 *a, b*.

It is distinguished from *Pupa doliolum* Brug. var. *batumensis* Ret., which stands nearest the species under consideration, by the shape of the aperture, the conspicuously strong spiral lamella, the columellar teeth, dimensions, shape of the shell and the strong callus. I allow myself the pleasure of giving it the name of the Director of the Caucasian Museum (*Rosen*).

Orcula tingitana Pallary. Pl. 19, fig. 9.

Vol. 27, p. 256. Pallary's figures (Journ. de Conchyl., Vol. 65, 1920, p. 133, pl. 2, fig. 15) are copied. The original locality was banks of the Oued Querrha (Lt. Brunot). Said to be

the only living *Orcula* of north Africa, where however there are two fossil species, *Pupa ectina* Bgt. (Vol. 26, p. 225) and *P. amblya* Bgt. (Vol. 27, p. 4).

Orcula turcica (Let.). Vol. 27, p. 23.

Orcula scyphus graecus Pils., Vol. 27, p. 36, appears to be practically identical with *O. turcica* Let., which is no doubt the inadequately defined *Pupa critica* Zel. of Pfeiffer, collected on Syra by Zelebor. In the Hesse collection I find specimens from the Piraeus, Lykabettos near Athens, Syra and Tinos Islands.

Orcula wagneri ljubetenensis Sturany.

By a typographical error the name was spelled "ljubetensis" in Vol. 27, p. 257.

Subgenus Orculella Steenberg.

Orculella Steenb. Videnskabelige Meddelelser fra Dansk. naturh. For. i Kobenhavn, vol. 80, 1925, p. 176, tod. *Orcula orientalis Pfr.*

This subgenus apparently includes the species No. 9 to No. 13 of the monograph in Manual vol. 27, pp. 27-36.

Not much can be done towards stabilizing the nomenclature of the Orculellæ until the internal lamellæ of *O. sirianocoriensis* of Cyprus, *O. orientalis,* type in Pfeiffer's collection, and *O. scyphus* from the type locality, Brusa, are examined, as these are the early names. The internal characters are also unknown in part of the named local forms.

Orcula orientalis (Pfr.). Vol. 27, p. 29.

The form from Lebanon, which Westerlund called var. *cedrorum,* has a quite weak lower-palatal fold half a whorl inward. The inner end of the parietal lamella flares outward, and there is a low cord-like lamella near and outside of the parietal lamella near its inner end.

The form common in the Sarus river debris at Adana, Cilicia, has no trace of a lower-palatal fold; otherwise similar to the preceding, the inner end of the parietal lamella flaring

outward and accompanied by a low callous cord. Size variable.

Length 11.3 diam., 4.6 mm.; 10 whorls.

Length 8.5 diam., 4 mm.; 9½ whorls.

Var. *antiochensis,* n. v. A broad form from Antioch (Hesse coll., from Berlier) which Hesse has identified as var. *nitida* Mouss. (Archiv f. Molluskenkunde, vol. 59, 1927, p. 177) has no lower-palatal fold within. In two of the three examples there are *two* cord-like lamellæ between the parietal lamella and the suture (pl. 19, figs. 10, 10*a*). In the third, only one lamella is there (Pl. 19, fig. 11).

Length 9.8, diam. 4.6 mm. (Fig. 10, 10*a*, type).

Length 10.5, diam. 5.0 mm.

Length 9.5, diam. 4.8 mm. (Fig. 11).

Whether this is really var. *nitida* of Mousson is not material, since that name cannot be used, being a homonym.

O. ORIENTALIS MOUSSONI Reinh. Pl. 19, figs. 12, 13, 13*a*.

Vol. 27, p. 36. In this form there is a very small lower-palatal fold, which is visible externally as a short white marking above the umbilical rima in fresh shells (fig. 13*a*), and internally appears as a very low callous fold (fig. 12). The specimens figured are from Aleppo, Hesse coll., and were recorded as *Orculella orientalis* in Archiv f. Molluskenkunde, vol. 59, p. 176, 1927.

VERTIGININAE (Vol. 25, p. 68).

Vertiginidae STIMPSON, Shells of New England, 1851, p. 53, including *Vertigo* and *Columella simplex* (Gld.).

VERTIGO (Vol. 25, p. 69).

American Species.

VERTIGO ELATIOR (Sterki). Vol. 25, p. 95.

I am inclined to rank this as a distinct species, differing from *V. ventricosa* by the constantly longer spire. The following appears to be a synonym.

Vertigo gouldii loessensis F. C. Baker (Pl. 15, fig. 2) was

thus described: "Shell differing from recent *gouldii* in being more ventricose, especially on the last whorl, having the apical whorls wider and more obtuse, the outer lip more auricled causing the aperture to have its longest diameter more diagonal than in *gouldii;* there are five denticles placed as in *gouldii,* but more delicate than in the typical form; the palatal denticles are long and subequal.

"Length 2.00; diameter 1.3 mm. Holotype.

"Length 2.00; diameter 1.3 mm. Paratype.

"Length 2.1; diameter 1.1 mm. Paratype." (*Baker*).

Illinois: 3½ miles east and 1¾ miles south of Lewistown, Fulton County (Liverpool township), in loess of Peorian age. Types: Museum Natural History, University of Illinois, No. P2366. Paratypes, Acad. Nat. Sci. Phila., No. 145107.

Vertigo gouldii loessensis F. C. Baker, Nautilus, Vol. 41, April, 1928, p. 135; Trans. Illinois State Acad. Sci. Vol. 21, 1929, p. 297 (Aftonian to Early Wisconsin loess).

"This Vertigo has been listed as *gouldii* but is different from the typical species as living today. It has also been listed as *ventricosa,* and some small, wide specimens do resemble this species. *Loessensis* strongly resembles *Vertigo elatior* Sterki, and Sterki has referred certain forms found in loess at New Harmony, Indiana to this species. They lack the strong palatal callus so characteristic of *elatior* and are the same as the Illinois variety here differentiated. It is probable that the Vertigo listed as *gouldii* by Hanna (Kansas Science Bull. VII, p. 120, pl. 18, fig. 4) is also this variety. It is found in the Pleistocene from Yarmouth to Early Wisconsin time. The form is here considered a marked variety of *gouldii* but it might be advisable to consider it a distinct species." (*Baker*).

A paratype of *loessensis* is figured. It resembles *V. elatior* in having a longer spire than *V. ventricossa.* The palatal folds of *elatior* stand on a more or less thick but variable callus. It is very thin in some Maine examples, heavier in those from Ohio. This palatal callus is distinctly developed in paratypes of *loessensis,* which does not appear separable from *elatior.*

In *V. gouldii* the striation, especially of the penult whorl, is much stronger, and the basal tooth is situated further to the left.

VERTIGO GOULDII PARADOXA Sterki. Pl. 15, fig. 5.

Vol. 25, p. 99. The specimens from Newfoundland referred to *V. coloradensis* and *V. coloradensis basidens* by Vanatta (Nautilus Vol. 40, p. 113, 1927, and 43, p. 134, 1930, seem to me to be *V. g. paradoxa*. None of them has a basal fold. The lower-palatal fold stands distinctly deeper than its fellow. In *V. gouldii* and *V. coloradensis* it is not quite so deeply immersed. The distinction is admitted to be rather finely drawn, but it appears to be valid. A Newfoundland specimen from Hannah's Head, Humber River, is figured, Pl. 15, fig. 5.

On going over the series I conclude that the Rocky Mountain shells, *V. coloradensis* and its subspecies, are not specifically distinct from *gouldii*. The differences are trivial, and while absolute continuity of the *gouldii* and *coloradensis* areas is not proven, and seems improbable, there is no great gap between the ranges as recorded in Manual Vol. 25, pp. 98, 115-118. I would therefore write *V. gouldii coloradensis, V. g. arizonensis,* etc.

Vertigo gouldii paradoxa appears to be generally spread in Newfoundland, the specimens being from Tucker's Head, east arm of Bonne Bay; Hannah's Head, Humber River, Bay of Islands; Ha Ha Cape, Ha Ha Bay; Bard Harbor Hill, highlands of St. John, on the Straits of Belle Isle. I have seen specimens of *V. g. paradoxa* from Anticosti Island also, in Museum of Comparative Zoology.

Junius Henderson (Nautilus Vol. 44, p. 9, 10) has raised the question whether the occurrence of *V. coloradensis* in Newfoundland " really means a survival of the species at the extreme eastern end of its pre-glacial range ". This question is hardly affected by the change in name of the Newfoundland specimens, since the Rocky Mountain and northeastern races, though not absolutely identical, seem to be barely distinguishable.

VERTIGO WHEELERI Pilsbry. Pl. 15, fig. 1.

The shell is rather obesely oval, the diameter about two-thirds of the length, cinnamon colored. The first 1½ whorls are pale and smooth; the rest are closely and finely striate, the striation rather strong, about as in *V. coloradensis;* it is somewhat coarser on the penult than on the last whorl. The whorls are strongly convex, the last near the outer lip becoming a litlte flattened peripherally, and having a weak, wide swelling or crest behind the outer and basal lips. The rather small aperture is broadly pear-shaped, obstructed by five teeth: the angular lamella is tuberculiform, the parietal lamella higher and rather long; columellar lamella horizontally entering, but rather short; the two palatal folds are short. The lip is slightly expanded, the outer margin noticeably straightened in the middle, and in a profile view seen to be weakly arched forward there.

Length 1.6, diam. 1.05 mm.; 4½ whorls.

Alabama: Monte Sano, near Huntsville, collected by H. E. Wheeler.

Vertigo wheeleri PILSBRY, in Walker's Terrestrial Shell-bearing Mollusca of Alabama, Univ. Michigan Misc. Pub. No. 18, 1928, p. 146, fig. 224. — *Vertigo concinnula* WHEELER, Nautilus XXV, 1912, p. 124, *cf.* PILSBRY, Man. Conch. XXV, p. 121.

This species has the broad, ventricose figure of *V. hebardi* Van., but is a larger, less fragile and more strongly striate shell, the columellar lamella differing in form. It is decidedly more ventricose than *V. gouldii* which, with five teeth as in *wheeleri,* has generally a second columellar and but one tooth on the parietal wall; however these two teeth are variable in *V. gouldii;* the main distinction is in the shape of the shell. These two species appear to be the nearest relatives of the new form. *V. rugosula* and *oralis* have much more strongly developed teeth and an outer lip of different shape.

Specimens presumably those now under consideration were shown me by Mr. H. E. Wheeler many years ago and were identified as *V. concinnula* Ckll., a Rocky Mountain species

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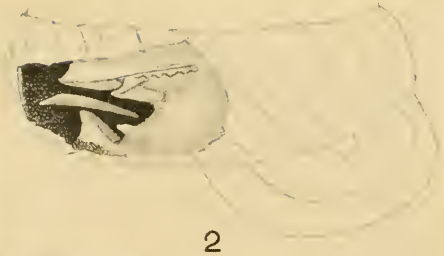
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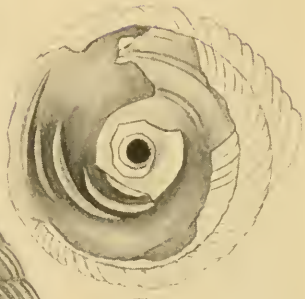
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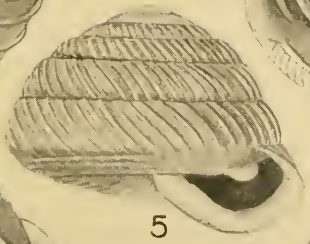
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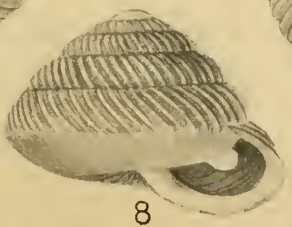
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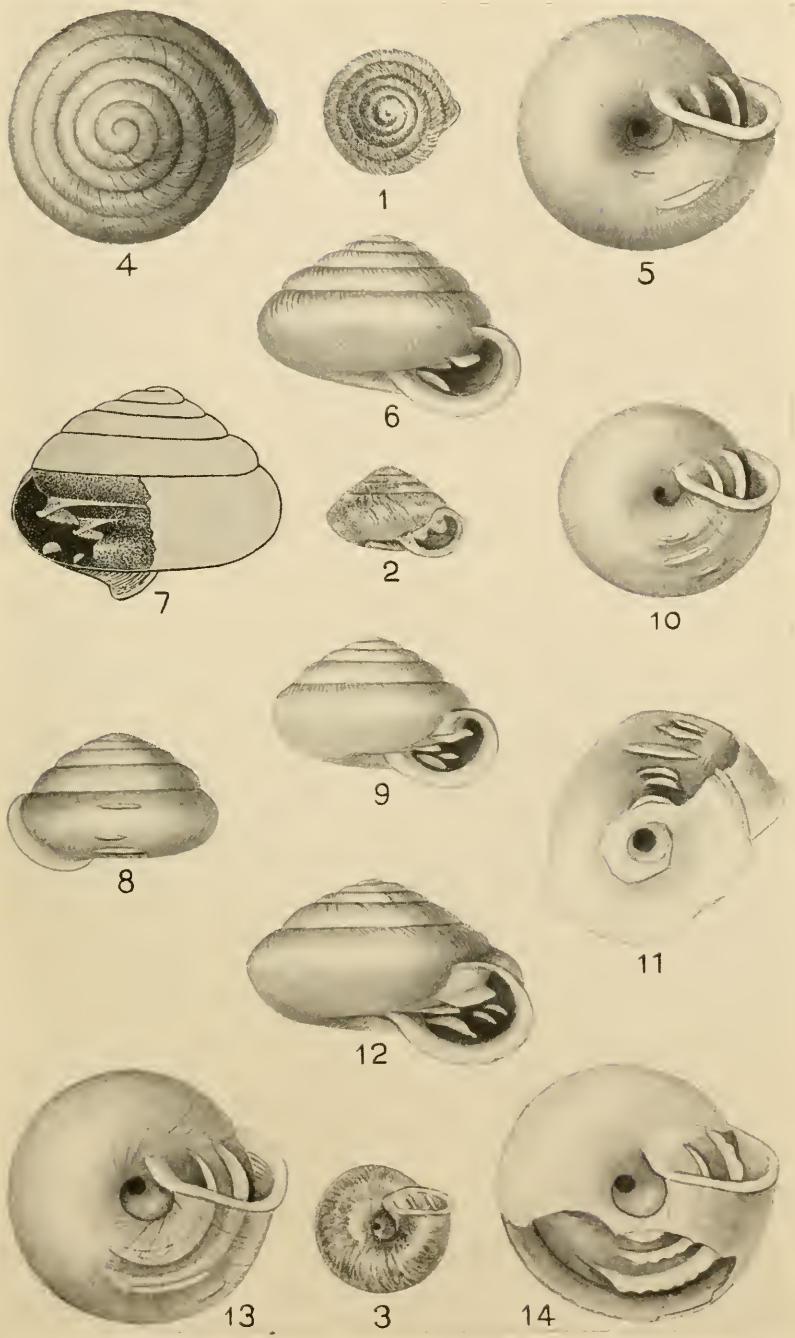
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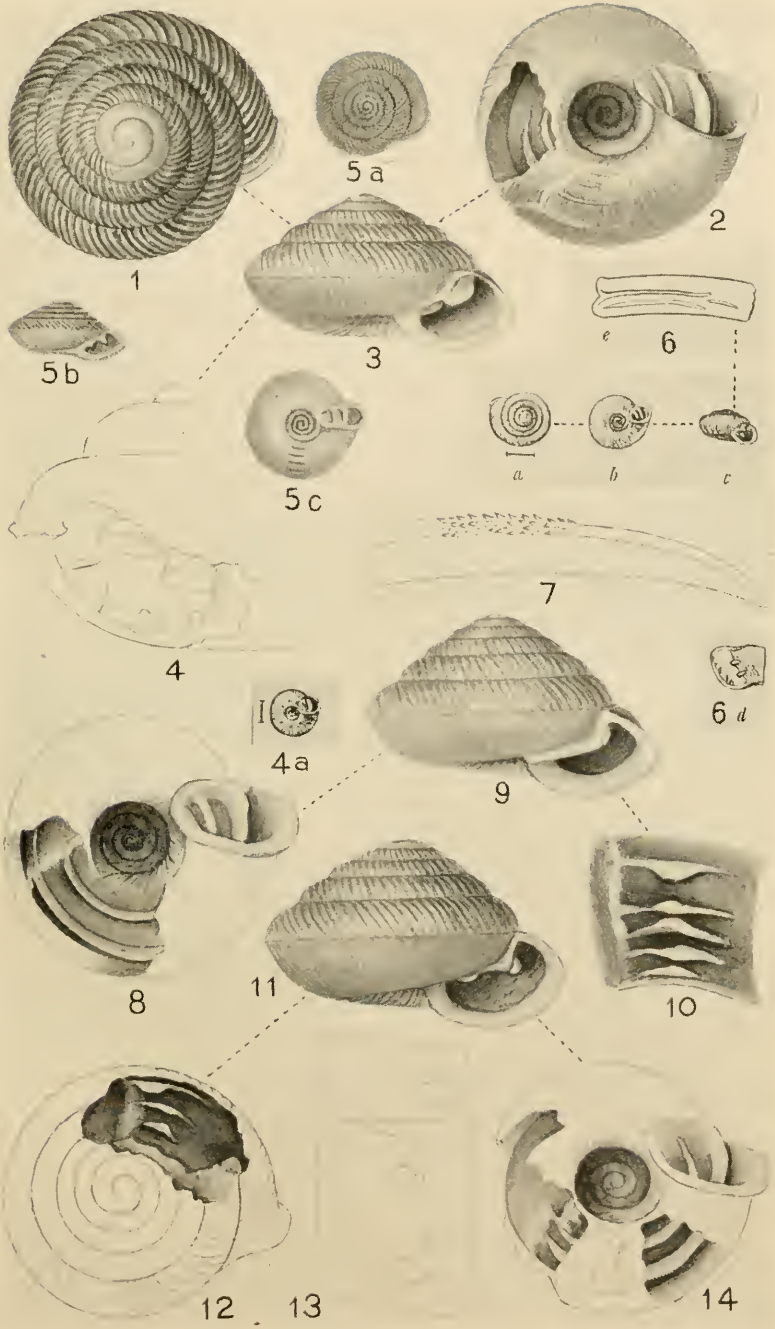
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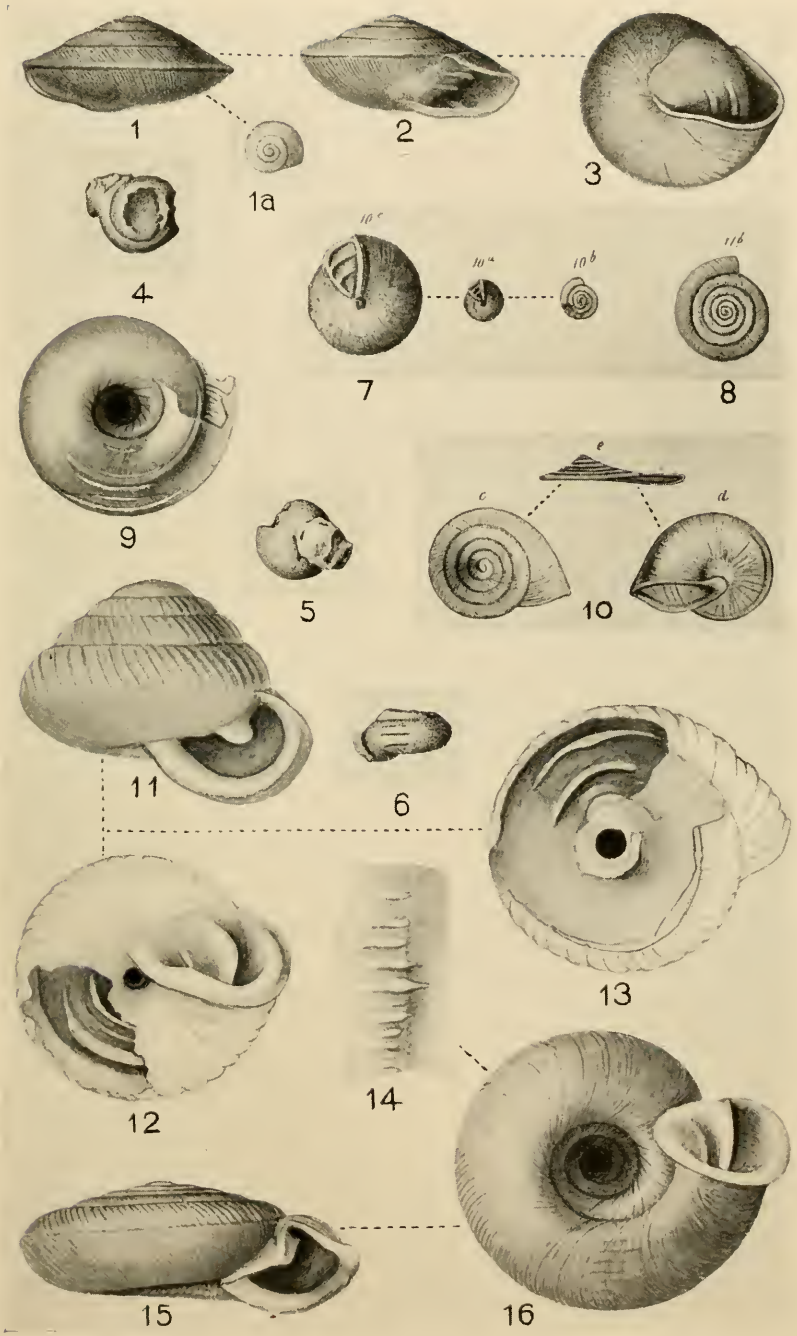
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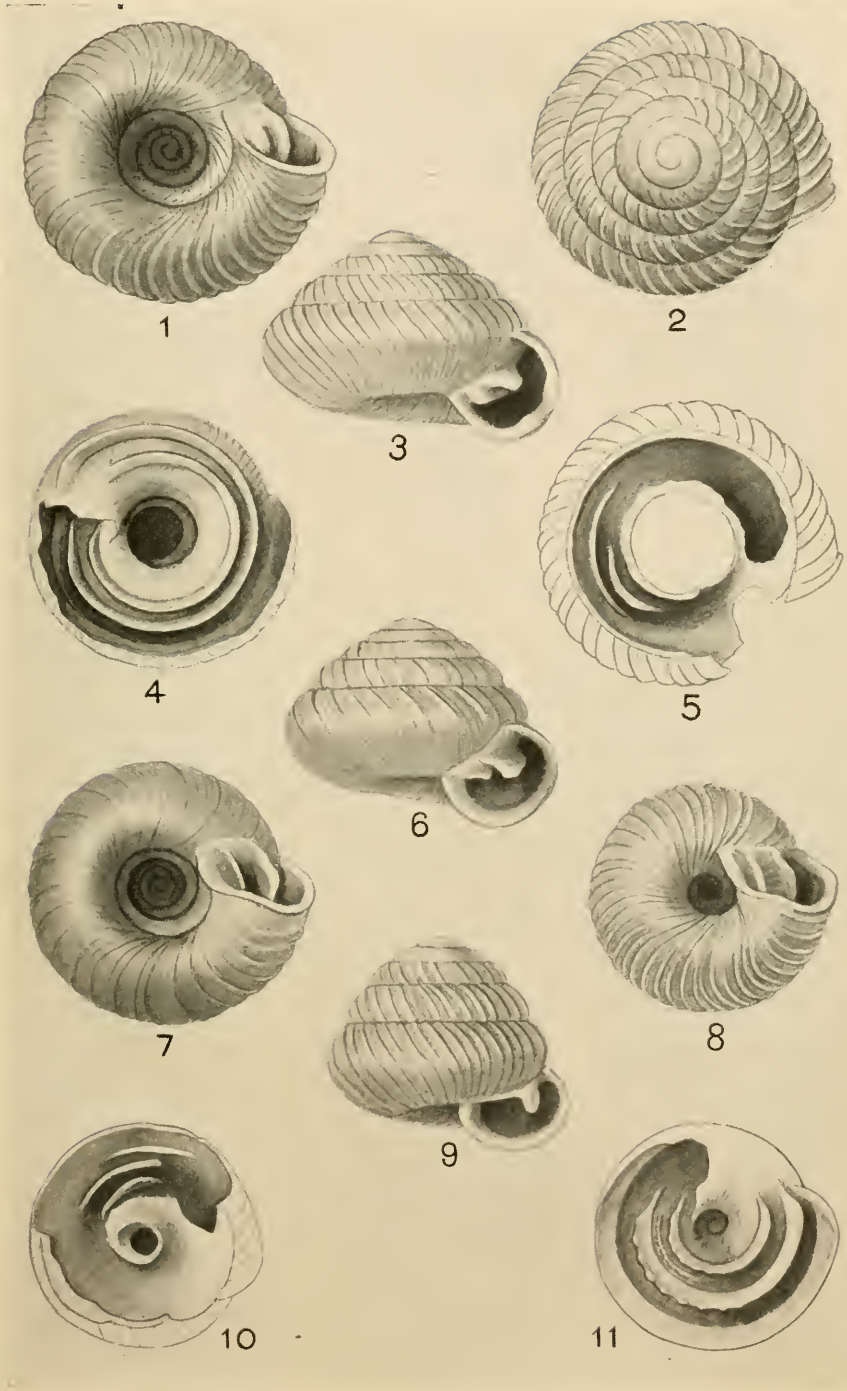
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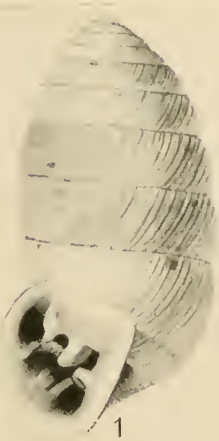

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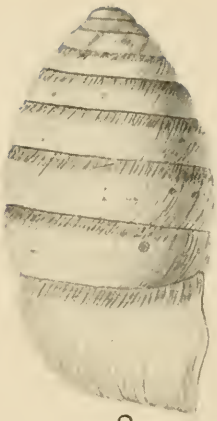

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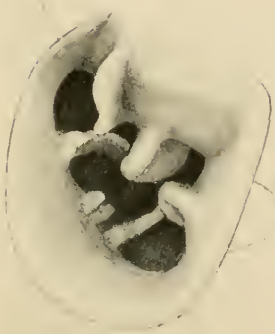

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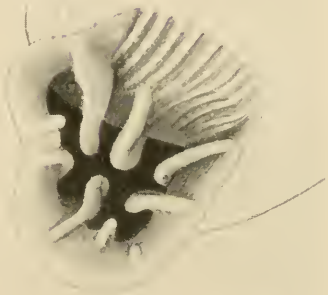

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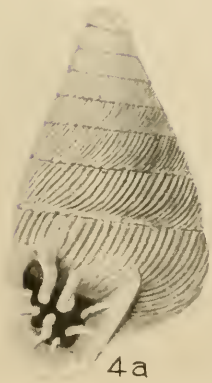

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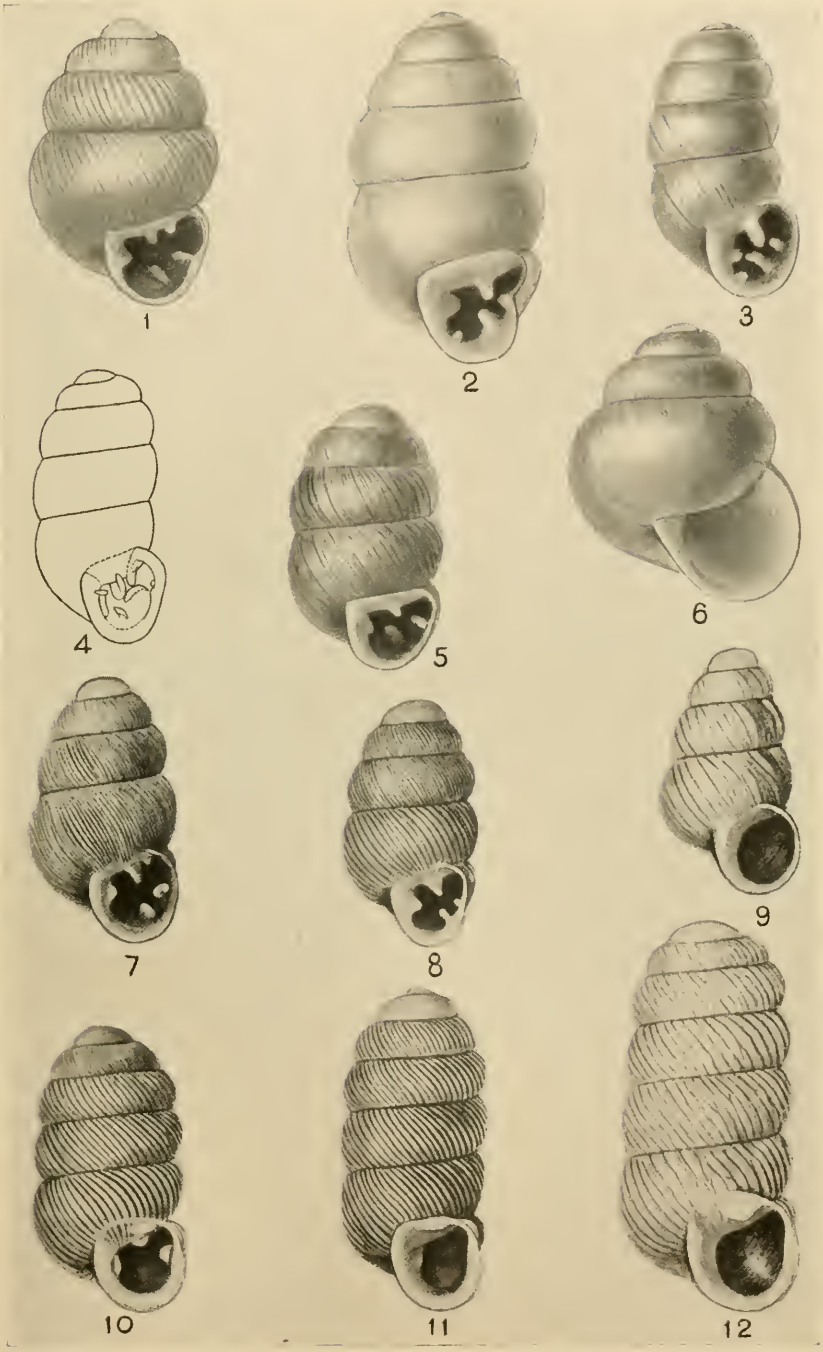
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(Nautilus XXV, 1912, p. 124). That is a larger shell, less inflated, with longer palatal folds, but very similar to the present form in sculpture.

VERTIGO COLUMBIANA Sterki. Vol. 25, p. 109, 18th line. Reference to figure of type of *V. c. utahensis* should stand: Pl. 12, fig. 13.

VERTIGO CALIFORNICA CATALINARIA (Sterki). Pl. 15, fig. 8.

The specimens from Guadalupe Island, off Lower California: at Northeast Anchorage and 1000 ft. above, and 2 miles north of the south end on the east side (G. D. Hanna), are darker than the Santa Catalina Island form, but no other difference was detected. There is some variation in diameter among them, also in the spacing of the ribs, the specimen figured having them more widely spaced than some others.

Length 1.95, diam. 1 mm.

Vertigo californica catalinaria (Sterki), PILSBRY, Proc. Cal. Acad. Sci. (4), XVI, 1927, p. 174, pl. 7, f. 5.

VERTIGO CALIFORNICA GUADALUPENSIS Pilsbry. Pl. 15, fig. 7.

The differential characters of this form are that it possesses a distinctly developed angular lamella standing about midway of the length of the long parietal lamella, and the striation is quite fine, there being about 30 striae in 1 mm. on the face of the last whorl. Length 2 mm.; diam. 1.1 mm.

Guadalupe Island, Lower California; collected about 1000 feet above the landing at Northeast Anchorage by G. D. Hanna.

Vertigo californica guadalupensis PILSBRY, Proc. Cal. Acad. Sci. (4), XVI, 1927, p. 175, pl. 7, fig. 4.

In most groups of Vertigo the presence or absence of an angular lamella has little significance, but in the *V. californica* group I have never seen this lamella in hundreds of shells examined. However, Dr. V. Sterki has mentioned seeing "traces" of an angular lamella in some specimens of *V. californica,* which is a larger, more coarsely sculptured form than *V. c. guadalupensis.* I have thought it best to name this

island form in order to stimulate the attention of future collectors. It was found associated with *V. c. catalinaria.*

VERTIGO DEGENERIS Pilsbry. Pl. 15, fig. 9.

The oblong, brown shell tapers from the last whorl to the obtuse apex. The whorls are strongly convex, almost smooth, but on the penult whorl some spaced wrinkles along growth lines are noticeable; though weak, they evidently correspond to the riblets of *V. californica.* The rounded aperture has no teeth. Columella concave, the columellar lip being rather broadly expanded. Length 1.9 mm., diam. 1.1 mm., 4½ whorls.

Guadalupe Island, Lower California: collected about 1000 feet above the landing at Northeast Anchorage by G. D. Hanna.

Vertigo degeneris PILS., Proc. Cal. Acad. Sci. (4) XVI, 1927, p. 175, pl. 7, fig. 6.

A strongly characterized form, which, however, may prove to be connected with a similarly toothless form found at Northeast Anchorage in which the riblets are well developed, length 1.8 mm., diam. 1.1 mm. As only broken examples of this ribbed form were taken, its status is left in suspense for the present.

VERTIGO TORREI Aguayo & Jaume. Pl. 24, fig. 1.

The shell is rimate, very small, ovate-conic, corneous, translucent, with a waxy luster, finely striate axially, the striation more distinct on early whorls and obsolete on the last. Suture deep. Whorls 4½, convex, the last well rounded; apex obtuse. Aperture transverse, semicircular, provided with seven ivory white teeth in all specimens examined, as follows: a small angular lamella; a high and thick parietal lamella, about twice as large as the angular and slightly oblique; a large columellar lamella which is slightly curved toward the apex of the shell; a basal lamella, well developed but more compressed, and three-fourths the length of the preceding; a lower-palatal fold, high, deep, and curving towards the columella; an upper-palatal fold, parallel to the preceding and of about the same

size; and a suprapalatal tooth, well developed in all specimens examined. Peristome ferruginous, expanded, very broad in the columellar margin, the outer margin with a deep inflection in the middle, and with three impressions behind, of which the shortest is above, the longest below. Length 1.75 mm., diam. 1.05 mm., aperture 0.6 x 0.73 mm. (*Aguayo & Jaume*).

Cuba: "La Lisa", Havana, under dead leaves in damp, shady places, collected by M. L. Jaume and A. Bierig. Holotype in Aguayo collection, paratypes in collections of Jaume, the Academy of Natural Sciences of Philadelphia, Mus. Comparative Zoology, Harvard, and U. S. National Museum.

Vertigo torrei Aguayo & Jaume, Univ. de la Habana Memorias de la Sociedad Poey, Vol. 8, no. 1, p. 11, text-fig., March 10, 1934.

Aguayo and Jaume add that this species resembles *V. ovata* Say in general appearance, but differs by the constantly smaller size, the more expanded columellar margin of the peristome, as well as by the number and form of the apertural teeth. In *V. ovata* an infraparietal lamella is often found, which appears in none of the examples of *V. torrei* observed. In the latter a suprapalatal tooth is always present, this being infrequent in *V. ovata*. *V. neglecta* Poey resembles our *torrei* in size and proportions, but lacks parietal teeth, yet it is possible that it was described from an imperfect example which had lost these teeth by wear. We were unable to find the type of *V. neglecta* in the Academia de Ciencias de la Habana. Probably it is lost. At present it appears that we have to consider *V. neglecta* as unindentifiable.

Vertigo gouldii hubrichti, n. subsp. Pl. 22, figs. 12, 13, 14.

The shell is subcylindric, larger than *V. nylanderi* Sterki, with a similar long and deep impression over the palatal folds. The lower-palatal is deeply immersed. There is no angular lamella. The basal fold is well developed. The intermediate whorls are strongly, sharply striate as in other forms of *V. gouldii*. It differs from *V. g. paradoxa* by the deep external impression over the palatal folds.

Length 2 mm., diam. 0.9 mm.; 5 to 5½ whorls.

Loess of Mona, St. Louis Co., Missouri. Type and paratypes 160362 A. N. S. P., collected by Mr. Leslie Hubricht.

VERTIGO IDAHOENSIS, n. sp. Pl. 22, figs. 9, 10, 11.

The shell is ovate, rimate, with convexly conic spire and obtuse summit; cinnamon-brown, the spire paler; glossy, with extremely weak and rather sparse lines of growth and a faint microscopic granulation. The whorls are strongly convex, the last having an impression at the lip-point, a very low, hardly noticeable crest, and behind it a deep pit over the lower-palatal fold. The peristome is distinctly bent in above the middle of the outer margin, well expanded below the point. Columellar margin reflected. There are four teeth: a well developed parietal lamella, a somewhat oblique columellar lamella, and two palatal folds rather near together, as in *V. ventricosa* and its allies, the lower-palatal being decidedly larger and a little further in. There is no palatal callus.

Length 2 mm., diam. 1.2 mm.; 4½ whorls.

Meadows, Adams Co., Idaho, along a creek east and northeast of the old town. Type and paratypes 158670 A. N. S. P., collected by H. Burrington Baker, Sept. 12-15, 1929.

The whorls are more convex and the suture deeper than in *V. ventricosa, V. columbiana* or *V. andrusiana,* and it differs from all of these by the much deeper external pit over the lower-palatal fold, the other species mentioned having the whorl only somewhat flattened there. The teeth are much the same in this whole *ventricosa* series, the palatal folds being nearer together than in the *V. modesta* series. The development of angular lamella and basal denticle is variable in some forms of the *ventricosa* group, but neither is present in specimens of *V. idahoensis* seen.

VERTIGO MODESTA SCULPTILIS, new mutation. Pl. 24, figs. 2, 3, 4.

The shell has rather sharp sculpture on the penult and antepenult whorls of the spire, as in *V. m. insculpta,* but it differs by the reduced size of the teeth; small parietal, columellar and lower-palatal being present in the specimen taken as type; in

others there may be minute traces of the upper-palatal fold and an angular lamella, but still other examples have only two teeth, no palatal folds being developed. Type 162884 A. N. S. P., from 2 to 10 miles up Rock Creek, northeast of Garrison, Montana, collected by H. Burrington Baker. It was taken also near the head of Wallowa Lake, Wallowa Co., Oregon, and at Aneroid Lake, about 8 miles south.

VERTIGO MILIUM Gld., var. Plate 21, figs. 16, 17.

Vol. 25, p. 146. Specimens from Rio Guayubin at crossing of Sabaneta Road, northwestern Santo Domingo, are figured to show the slightly different race of that island. The shell differs from *V. milium* by the decidedly shorter lower-palatal fold, which is wholly visible in a direct front view (but in *milium* longer, the end passing out of view), and by the heavy, calloused columellar lamella. In *milium* the inner end turns downward, but in *antillarum* it is brought forward almost as far as the upper end, the space between the two ends being largely filled with callus. The shell is of a compact, oval shape, finely striate, especially the penult whorl. The specimens figured are No. 160406 A. N. S. P., collected by A. A. Olsson.

Chinese Species.

VERTIGO TEILHARDI Ping and Yen. Plate 24, figs. 7, 8, 9.

"Shell minute, rimate, ovoid. Apex very small, slightly higher than first whorl. Whorls about 4½, increasing gradual in first two and gradually in last two. Body whorl more than ⅔ of the total length of the shell. Surfaces of the first two whorls moderately convex, while that of the last two more convex, body whorl with its base much reduced. Apex and first three whorls look free from striae under ordinary magnifying lens, and body whorl with extremely fine striae, which become a wrinkle or crease close to the aperture. Sutures well developed, distinct owing to convex surfaces of whorls. Aperture somewhat cardiform, if the inwardly bent outer lip be taken as its base. It bears 6 teeth within: the parietal tooth slightly larger than the angular which is small but not obsolete.

The columellar about as large as parietal. The basal rather small and quite near the posterior end of columella. The two palatal teeth or lamellae well developed which are not smaller than either parietal or columellar, although they are of comparatively slender ridges. The upper one of the palatal teeth situated on the inner side of the concavity of the outer lip looking slightly thicker than the lower one. Outer and inner lips slightly thick, simple and smooth, with a little tendency of being expanded. Umbilicus very narrow.

"The apex and second whorl are grayish white, the rest of the shell is rufous brown, and the aperture, apertural teeth and the peristomal region pale or whitish. When the shells are comparative worn, the surface is almost uniformly grayish white" (*Ping and Yen*).

Alt. 2.2 mm., diam. 1.2 mm., length of aperture 0.5 mm., width of aperture 0.75 mm.

N. W. China: Aksu, in a dry river bed. Type No. 545 Fan Mem. Inst. Biol.

Vertigo teilhardi Ping and *Yen*, Bull. Fan Memorial Institute of Biology, vol. 4, p. 277, fig. 14; March 15, 1933.

" This species resembles in some respects *Vertigo eogea* Pilsbry, 1919, described from Kashima, Harima of central Japan. The present species is, however, differentiated from the latter by its less broad outline, its palatal and basal teeth separated from each other without ' a strong buff callus', and its slightly larger size, with but one volution less" (*Ping* and *Yen*).

European Species.

VERTIGO PUSILLA GODETIANA Piaget.

Shell normal except that the peristome is thinner, subcontinuous, the right margin not arched in, the parietal wall one-toothed. Length 1.5 mm., diam. 1 mm. (*Piaget*).

Switzerland: Pierrabot (Godet); Quaternary sandy alluvial deposit in front of Champion (Gampelen), near the road to Infini.

[*Vertigo pusilla*] var. *godetiana* J. PIAGET, Mittheil. Naturf. Ges. Bern, Jahrg. 1913 (1914), p. 156.

VERTIGO LILLJEBORGI West. (Vol. 25, p. 167; vol. 27, p. 218).

According to Esmark (Skrifter Norske Videnskaps-Akad. i Oslo, 1925, p. 50), *Vertigo pachygaster* Jensen (Vol. 25, p. 182) is only a light-colored shell of *V. lilljeborgi,* deviating a little in form.

VERTIGO MOULINSIANA (Dup.) Vol. 25, p. 178.

Pupa desmoulinsiana Jeffreys, 1855 (Vol. 25, p. 179, line 19) and *Vertigo moulinsiana* Jeffr., Brit. Conch. 1, 1862, p. 255; V, pl. 15, f. 6, are referable to *Vertigo lilljeborgi* according to Kennard and Woodward, Syn. Brit. Non-Marine Moll., 1926, p. 123.

On p. 179, 23d line, the reference to the synonym "*Pupa laevigata*", is erroneous. The paragraph should read: *Vertigo laevigata* Kokeil, VON GALLENSTEIN, Kärntens Land- und Süsswasser-Conchylien, in Jahrb. naturhist. Landesmuseums von Kärnten, 1852, p. 80.—*Pupa laevigata* Kokeil, PFEIFFER, Monographia IV, 1859, p. 681.

VERTIGO ARCTICA Wallenb. Vol. 25, p. 189.

G. Mermod (Revue Suisse de Zoologie, Vol. 33, July, 1926, p. 568-571) examined the type lot of *Vertigo "eumicra* Bgt." of Clessin (Vol. 26, p. 233), one of which he figured (t.c. p. 570, fig. 7, shell, p. 571, fig. 8, radula). It is a toothless form of *V. arctica,* in his opinion.

Vertigo zschokkei Butikofer (Vol. 27, p. 219) was also examined and submitted to other authorities. The large form of *V. zschokkei* is considered a bidentate form of *V. arctica* (Mermod, t. c., p. 571-576, figs. 9). His figures are copied in my Pl. 18, figs. 11, 12. The small form of "*V. zschokkei*" is said to be identical with *V. parcedentata* Al. Braun.

VERTIGO SUBSTRIATA Jeffr. Vol. 25, p. 172.

The occurrence of this species in the Netherlands, and its status as a "glacial relict" as supposed by some authors, is

discussed by Dr. A. L. J. Sunier in Zoologische Mededeelingen, Rijks Museum van Nat. Hist., Leiden, IX, 113-178.

VERTIGO GENESII Gredler. Pl. 18, figs. 13-16.

The characters and distribution have been discussed by A. W. Stelfox and R. A. Phillips in Journ. of Conch., Vol. 17, July, 1925, p. 236-240, with figures of a topotype from Salten (reproduced in my Pl. 18, fig. 14), and of Irish specimens (reproduced in Pl. 18, fig. 13, Fancraft marl bed; fig. 15, marl at Golden Grove; fig. 16, marshy pasture near Mountmellick, Queen's Co., Ireland).

V. parcedentata Al. Braun, received from Geyer, is said by Stelfox to be "more cylindric and *alpestris*-shaped" than the Irish shells.

See also this Manual, Vol. 27, p. 216, and Geyer, Archiv für Molluskenkunde, Vol. 57, 1925, p. 99-102, where Sandberger's figures of *parcedentata* are discussed, and a grouping of European dextral Vertigo species is proposed.

VERTIGO GENESII GEYERI Lindholm. Pl. 18, fig. 17.

Shell dextral, minute, rimate, ovate, obtuse, deep brown or chestnut, lightly striatulate, glossy. Whorls 4½, convex, the first three slowly, last two rapidly increasing and somewhat swollen, separated by a deep suture which ascends slightly in front. Aperture semioval with the margins nearly straight, the right regularly arcuate or slightly subconstricted, the columellar vertical, dilated and reflected above; four-toothed, one remote, subcompressed strong parietal, one conic, strong, lamella in the middle of the columella, two unconnected palatals, the larger nodiform or pliciform below the middle of the margin, a very minute denticle above the middle; palatal and cervical calluses wanting. Alt. 2 mm., diam. 1 mm. (*Lindholm*).

Württembergischen Allgau; Tirol; Poland and European Russia. Tirol: Salten (D. Geyer). U.S.S.R.: Wlachernskaja, Gouv. Moskau; Ishora R. debris, Gouv. St. Petersburg (Lindholm); shore meadow of Tscheremenstzkoje Lake, Gouv. St. Petersburg (I. K. Wislouch). Fossil in peat-bog of Pfohren near Donaueschingen (D. Geyer).

Vertigo genesii Gredler subsp. *geyeri* Lindholm, Archiv für Molluskenkunde, LVII, 1925, p. 241-251, fig.

The passages quoted from Geyer in Manual Vol. 25, p. 205, evidently refer to *V. g. geyeri.* According to Lindholm, in all three Russian localities this form occurs without mixture with the typical toothless *V. genesii.* Grown specimens differ from *V. antivertigo* and *V. lilljeborgi* (with which they agree well in luster, sculpture and color) by the entire absence of the cervical crest. In *V. pygmaea* var. *callocarens* the two palatal folds are united by a palatal callus, not developed in *V. g. geyeri.*

TRUNCATELLINA (Vol. 26, p. 58).

Vol. 26, p. 63, third line: for "*Truncatella*" read *Truncatellina.*

Truncatellina cylindrica (Fér.) (Vol. 26, p. 65).

Odhner states that the types of *Pupa odontostoma* Westerlund (Vol. 26, p. 78) in the Museum at Gothenburg are in all respects identical with *T. cylindrica.* The sculpture is of similar riblets, not striae as stated in the description, and the aperture shows no trace of teeth. It is not even a variety. Esmark agrees with this synonymy. (*cf.* Arkiv f. Zoologi, vol. 16, No. 29, 1924, p. 4; Skrifter Norske Videnskaps-Akad. i Oslo, 1925, p. 118).

Truncatellina cylindrica costigerella Lindholm.

Differs from the type by the costulate (not striate) shell, as in *T. costulata* Nilss. Size, color and aperture as in the type.

Crimea: widely distributed, for instance at Kisil-Koba; Nishnjaja Massandra; Merdwen, and other places.

Truncatellina cylindrica (Fér.) var. *costigerella* Lindholm, Archiv f. Molluskenk. LVIII, 1926, pp. 166, 176.

"Together with specimens of *T. cylindrica* Fér. typical in sculpture, size and coloring, a second form occurs in the Crimea, not specifically separable from *T. cylindrica,* but distinguished distinctly from German, French and Russian ex-

amples in my collection by the ribbing being double as coarse. In this it approaches *T. costulata* Nilss., but naturally has no apertural armature whatever, and a thin peristome, in the full grown stage.

" The var. *costigerella* predominates alone in a few places, in others being mixed with typical specimens, and connected therewith by transitions which stand about midway in sculpture " (*Lindholm*).

TRUNCATELLINA TAURICOLA Lindholm.

Shell rimate, rather small, cylindric, slightly attenuate near the apex, under the lens seen to be very delicately striate; deep reddish brown, at the apex ashy. Whorls 6, a little convex, slowly and regularly increasing, separated by an impressed suture, the last whorl slightly ascending. Aperture oblong-subcircular, toothless, the peristome a little reflected, thin.

Length 2 mm., width 0.8 mm. (*Lindholm*).

Crimea: Tschatyr Dagh (Lindholm).

Truncatellina tauricola LINDH., Archiv f. Molluskenk. LVIII, 1926, p. 177.

This form, of which two grown, living specimens were taken, differs from *T. cylindrica* by the dark reddish-brown color and the extremely fine striation, so that it does not fall within the hitherto known variation amplitude of *T. cylindrica.* By the two characters mentioned it recalls *T. monodon* Held (*T. striata* Grdl.). But a direct comparison of Tyrolese specimens of this species with the Crimean snail shows that the latter has conspicuously more convex whorls and a more deeply impressed suture than in *T. monodon,* which moreover is one of the toothed truncatellinas (*Lindholm*).

TRUNCATELLINA SUNDLERI Odhner. Pl. 21, figs. 1-3.

Shell cylindric (with the contours of the right and left sides parallel from the fourth to the last whorl), roundly truncate above, glossy, reddish horn-brown, striate, very narrowly umbilicate. Whorls 6, well rounded, with deep,

simple suture. Protoconch (1½ upper whorls) smooth, whitish, the following two whorls rapidly increasing in width, horn-brown, rather coarsely, irregularly and very obliquely striate; the three following whorls of equal width, colored and striate like those above, progressively increasing in height, the lower always higher than the preceding; last whorl 1½ times as high as the penult. On the lowest whorls are indistinct traces of a microscopic spiral striation. Suture ascends a little to the aperture. The aperture is small, rounded triangular, with simple, not thickened lip. Columellar margin gradually widening above, reflected, white. Parietal wall with a thin white callus. On the parietal wall is a projecting, short (not entering) lamelliform white tooth; on the straight columella a longitudinal callus within, forming a little brownish eminence, under it a distinct sinus.

Height 2.25 mm., breadth 1 mm. (*Odhner*).

Sweden: Schonen, near Krageholm, on stone wall at the south end of the garden, under moss (A. Nilsson).

Truncatellina sundleri Hj. Odhner, Arkiv för Zoologi, XVI, No. 29, p. 1, figs. 1-5. 1924.

Up to this time only two examples of this apparently endemic species are at hand, which moreover are of somewhat different forms. One is a little higher, though with the aperture not fully developed, as it has no trace of the parietal tooth and also a weaker columella callus. In order to clear up the affinities of the new species the radulae of *T. monodon, T. costulata* and *T. cylindrica* are repeated here. It appears that the differences between *T. sundleri* and the other two Swedish species relate only to minor details. The radula of *T. monodon,* on the other hand, differs considerably from those of all Swedish species, as the accessory cusps of the lateral teeth are very unequal in length; the inner is about double the size of the outer.

The conchological affinities of the new species are the reverse: it differs significantly from known Swedish species by the larger shell, darker color and finer sculpture. In the latter respects, as well as in the presence of a parietal tooth,

T. sundleri agrees well with *T. monodon*. The new species however has a larger shell, a much smaller columellar callus, no impression on the neck and no parietal tooth standing far within the aperture, such as is distinctly observable in the last named species (*Odhner*).

Truncatellina strobeli (Gredler). Vol. 26, p. 71, Vol. 27, p. 229.

Lothar Forcart has discussed the nomenclature in Archiv für Molluskenkunde LX, 188 (May, 1928). He quotes Gredler's description from III Programm des K. K. Gymnasium zu Bozen, which appeared prior to September, 1853, therefore prior to Benson's publication of *Pupa rivierana*.

Having examined Hartmann's specimens of *P. minutissima* preserved in the Natural History Museum of St. Gallen, Forcart states that he could not confirm the presence of teeth in any of the 33 examples, notwithstanding Hartmann's statement that the aperture has one tooth.

Forcart does not accept the earliest name, *callicratis* Scacchi, because Scacchi stated that his species was toothless.

Gredler's description appears to be *the first recognizable definition* of the species, though several earlier names are conjectured to pertain to it with more or less probability. I am now disposed to agree with Forcart in brushing aside the insufficiently diagnostic early work, noticed in Vol. 26, pp. 73-75, in favor of *T. strobeli* Gredler.

Perhaps "*Pagodina*" *bourguignati* Cout. (27 : 179) is really *T. strobeli*.

Truncatellina clavella (Reinh.) Vol. 26, p. 81.

Rosen (Mittheil. Kaukasischen Mus. Vol. 6, 1914, p. 194) treats this as specifically distinct.

Truncatellina micra (Ping). *Pupa micra* Ping, 1929. Palaeontologia Sinica, Ser. B, VI, fasc. 5, p. 18, f. 4*a*, *b*; pl. 2, f. 10*a*, *b*. Chou Kou Tien, Hopei Prov., China. "Polycene" (Lower Quaternary) red clay. This genus, which was not known from China before, seems indicated by the terms of Ping's description.

COLUMELLA (Vol. 27, p. 232).

COLUMELLA EDENTULA (Drap.). Vol. 27, p. 236.

Vertigo cylindrica Colbeau (Vol. 25, p. 214) is considered by Major Paul Dupuis to be an abnormal form of *Columella edentula* (Ann. Soc. Roy. Zool. de Belg. LV, 1924, pp. 50, 51, fig. 1. 1925).

COLUMELLA PYGMAEORUM Pils. & Ckll. Pl. 22, fig. 1.

The minute shell is sinistral, deeply rimate, subcylindric, the upper third distinctly tapering to the obtuse apex, of a pale, light brown tint; the surface dull, without evident sculpture under a lens. Outlines of the spire are somewhat convex. Whorls strongly convex and very gradually enlarging, the last ascending slightly to the aperture. The aperture is longer than wide, toothless. Peristome thin, the outer margin not expanded, arching forward slightly; columellar lip somewhat dilated. The umbilical chink is deep and rather long, with deep axial pit, but we believe no actual perforation beyond the last whorl.

Length 2.4 mm., diam. 1.1 mm., aperture 0.75 x 0.6 mm.; 8¼ whorls.

Belgian Congo at Tshibinda, west of Lake Kivu, at about 6000 ft. Type 159672 A. N. S. P., paratype in Brit. Mus. (Cockerell-Mackie-Ogilvie Exped.)

Columella pygmaeorum PILSBRY and COCKERELL, Proc. Zool. Soc., London, 1933, p. 374, pl. 2, fig. 3.

This species has the essential shell-structure of *Columella,* but is peculiar in its narrow form, long taper and sinistral coil, as well as by its diminutive size. It is the first Ethiopian species of the genus.

STERKIA (Vol. 26, p. 49).

The species were numbered incorrectly in the key on pages 50, 51. Probably *S. rhoadsi* and *S. antillensis* would be better treated as subspecies of *S. eyriesi.*

Sterkia calamitosa martiniana Pils. Pl. 15, fig. 4.

The shell is very similar to *S. calamitosa* but differs by the larger size and longer whorls, and the presence of a supra-palatal tubercle (rarely wanting).

Length 1.95 mm., diam. 0.9 mm.; fully 5 whorls. Type.

Length 1.75 mm., diam. 0.9 mm.; 5 whorls. Paratype.

Length 1.60 mm., diam. 0.9 mm.; smallest.

San Martin Island, off Lower California, under stones among plant debris (G. D. Hanna).

Sterkia calamitosa martiniana Pilsbry, Proc. Calif. Acad. Sci. (4), vol. 16, p. 186, pl. 12, fig. 2. April 22, 1927.

There are a few beautiful albino specimens in the lot. While very close to mainland *calamitosa*, the small differences seem to indicate a slightly differentiated insular race.

NESOPUPA (Vol. 25, p. 274).

Nesopupa corrugata (Preston). Vol. 25, p. 362, 5th line from bottom: for Fig. 14 read Fig. 12.

Nesopupa rodriguezensis Connolly. Pl. 21, fig. 8.

Shell minute, acuminate ovate, rimate, smooth, semi-transparent, moderately glossy, dark corneous brown. Spire moderately produced, sides convex, apex bluntly rounded. Whorls 4¼, rather convex, gradually increasing; apex smoothly granulate; remainder, under fifty-fold magnification, similarly granulate and sculptured with regular, nearly straight, fine, slightly oblique transverse striolae, a little less than half as broad as the space between them; suture deep and simple. Aperture subquadrate, rounded at the base; peristome whitish, very slightly expanded, outer lip nearly straight and perpendicular in profile, but conspicuously sinuate in plane just below the suture, dental process five-fold: a short blunt plait at the angle of the paries and outer lip, and a much longer one, parallel to it and much more deeply inset, in the centre of the paries; a conspicuous denticle, equally deeply inset, running out towards the point of the latter from the base of the sinulus; a longer denticle, more deeply inset

and slightly inclined to the left, just to the right centre of the base, and a shorter one, nearly as deeply inset and slightly inclined toward the base, a little more than halfway up the columella, which is weak, erect, slightly concave, with margin broadly expanded, but not obscuring the rima (*Connolly*).

Long. 1.3, lat. 0.75 mm.

Rodriguez Island (Snell and Thomasset). The type has been presented by H. P. Thomasset to the British Museum.

Nesopupa rodriguezensis Connolly, Journal of Conchology XVII, Oct., 1925, p. 262, fig. 4.

In view of the numerous insufficiently described and poorly figured species of Pupillidae recorded from the Mascarene Is., I am very chary of adding to their number. However, careful study of Pilsbry's Manual, vol. XXV, seems to show only one, *N. minutalis* (Morl.) from Mayotte, which can be compared with the Rodriguez shell. The following points from Pilsbry's description of *minutalis* should be found on comparison with mine of *rodriguezensis* to establish what must surely be specific difference between them.

In *minutalis*:—

(a) The surface is dull, with some irregular striation.

(b) The angular lamella is quite low, forwardly diverging from the parietal and joining, or almost joining, the outer lip.

(c) The parietal lamella is high.

(d) There are two quite short palatal folds; the upper palatal is sometimes very small.

N. bisulcata rhodesiana Pilsb., from the Victoria Falls, appears to resemble more closely the new species, but is larger, with stronger sculpture and longer denticles (*Connolly*).

Nesopupa vengoensis Connolly. Pl. 21, fig. 9.

The minute shell is almost exactly a replica of *N. griqualandica* (M. & P.), but is slightly less strongly striate, and differs clearly and constantly in dentition, the lower palatal fold being absent and the basal tooth so much more deep set that in some specimens it is hardly visible (*Connolly*).

Length 1.6, width 0.8, aperture alt. 0.5, width 0.5, last whorl 1 mm.

Portuguese East Africa: Mount Vengo, Lorenzo Marques, 5500 ft. (Bernard Cressy).

Nesopupa (*Afripupa*) *vengoensis* CONNOLLY, Trans. Roy. Soc. S. Africa, vol. 12, 1925, p. 165, pl. 4, f. 23.

I would have been inclined to regard this race as merely a subspecies of *griqualandica* were it not that the exact number of palatal folds is now considered of sectional importance in the genus *Ptychotrema,* so should presumably be of at least specific importance in the Pupillidae (*Connolly*).

NESOPUPA ARMATA (Pease). Vol. 25, p. 327.

" Last July Mrs. Cockerell visited the Island of Rarotonga, and collected there a *Nesopupa* which can by no means be separated from *N. armata,* described from Borabora, Society Islands. The aperture is fully armed with the characteristic lamellae, as figured by Pilsbry, only the infraparietal lamella is larger, quite half as long as the parietal. The shell is about 2.3 mm. long, with the characteristic sculpture, the upper whorls with remote cuticular riblets. This is the first record of a *Nesopupa* from *Rarotonga,* since it appears that *N. dentifera* (Pease), supposed to be from there, came from Aitutaki. Our shell does not agree with Pilsbry's figure of *N. dentifera,* but it may be that the latter is a varietal form of *armata.* Since the fauna of the Polynesian Islands is in general so extremely different from that of the Hawaiian group, and the sculpture of typical *Nesopupa* is so distinctive, it would seem that *Nesopupilla* and other groups should be regarded as generically distinct" (*T. D. A. Cockerell,* Jour. of Conch. XVII, 1924, p. 168).

NESOPUPA NOVOPOMMERANA Rensch. Pl. 21, fig. 5.

Shell ovate, translucent, dark brown, the apex paler; perforate; 5 whorls. Suture deep. Aperture rounded, the peristome expanded, whitish, with 5 lamellae: angular lamella low and short; parietal lamella long and higher; the palatal and columellar lamellae as opposed to the basal lamella [lower-palatal fold] smaller. The last whorl with a quite weak im-

pression at the place of the palatal lamella. After some delicate growth striae sharp ribs, unevenly spaced, appear, and the whole surface is sculptured besides with a finely tubercular structure (*Rensch*).

Height 1.9 to 2 mm., diam. 1.1 to 1.2 mm.

Bismarck Archipelago: Karlei, New Pommerania (*Josef Schneider*).

Nesopupa novopommerana RENSCH, Zool. Anzeiger, vol. 98, p. 35, fig. 7. March, 1932. Type in Zool. Mus. Berlin.

This species is evidently an *Insulipupa*, close to *N. barrackporensis, N. malayana*, etc., not nearly related to *N. cocosensis*.

Rensch remarks that with this species the genus *Nesopupa* is recognized from New Pommerania for the first time. . . . The New Pommeranian species is most similar in shape, color, dentition and sculpture to *N. cocosensis* Dall. *N. cocosensis* is larger throughout, the peristome is corneous to reddish-brown (the New Pommeranian perhaps older and therefore white lipped), the aperture is relatively larger, and the superficial sculpture lacks the ribs, therefore the tubercular structure appears more strongly developed than in *N. novopommerana*.

NESOPUPA QUADRASI TRANSAEQUATORIALIS Rensch.

Differs from *N. quadrasi* (Mldff.) of Guam [see vol. 25, p. 335] by the less deep suture and therefore less strongly convex whorls, by the somewhat stronger impression of the palatal fold and by the surface structure: the tuberculation of the surface is very strongly expressed in the New Pommeranian form, while the ribs are less prominent, just the opposite of the Guam specimens before me.

Height 1.5 to 1.8 mm., diam. 1 to 1.1 mm. The specimens from Guam are uniformly somewhat higher; the type is 1.7 mm. high, 1 wide (*Rensch*).

Bismarck Archipelago: Malkong, Wide Bay, New Pommerania.

Nesopupa quadrasi transaequatorialis RENSCH, Zool. Anzeiger, vol. 98, p. 36. March, 1932. Type in Zool. Mus. Berlin.

BOTHRIOPUPA (Vol. 24, p. 226; Vol. 27, p. 228).

BOTHRIOPUPA PERUVIANA, new species. Pl. 16, fig. 6.

The ovate-conic shell has a deep, comma-shaped axial crevice. Color cinnamon to snuff brown. The rather glossy surface is minutely, irregularly pitted throughout, with some wrinkles along growth lines on the intermediate whorls. The whorls are strongly convex, joined by a deep suture. The peristome is white, expanded, slightly thickened within. Parietal lamella strong. Upper and lower palatal folds small, subequal, the latter slightly further in. Columellar lamella median, receding.

Length 1.7 mm., diam. 1.2 mm.; 4½ whorls.

Peru: Quebrada Boca Pan, below Trigal, Dept. of Tumbez (A. A. Olsson). Type and paratypes No. 152673 ANSP.

The teeth are decidedly smaller than in *B. tenuidens* (C. B. Ad.). It differs from *T. breviconus* Pils. by the more elevated conic shape and the longer aperture. Three specimens were collected.

PUPISOMA (Vol. 26, p. 19).

PUPISOMA DIOSCORICOLA (C.B.Ad.). Vol. 26, p. 36.

This widely spread species has been reported from Serra da Baturite, State of Ceara, Brazil (Fred Baker, Proc. A.N.S. Phila. 1913, p. 632). I found it with the following species at the upper limit of the wooded zone of Chatham Island, Galapagos (Pinchot Exped.). It is one of the most widely spread snails of tropical America.

PUPISOMA GALAPAGORUM, new species. Pl. 16, figs. 7, 8, 9.

The shell is globosely conic, or turbinate, the diameter about 87 per cent of the height, with obtuse apex; umbilicate, the umbilicus contained about five times in the diameter; cinnamon-brown. Sculpture of fine, close wrinkles, irregularly developed, being weak or nearly effaced in places, and absent on the embryonic 1½ whorls; also a weak and very minute pitting, which is also quite irregularly developed, and in some places replaced by granulation. There is no spiral striation.

The whorls are strongly convex, joined by a very deeply impressed suture; the last whorl rounded basally around the open umbilicus. The aperture is rotund, slightly oblique. Lip thin, the columellar margin broadly reflected, half covering the umbilicus in a front view, but scarcely impinging upon it in a basal view.

Length 1.56 mm., diam. 1.36 mm.; 3⅔ whorls.

Length 1.6 mm., diam. 1.31 mm.; 3⅔ whorls.

Galapagos Is.: Chatham Island, on a wooded hill on the right side of the road from Wreck Bay to Progreso, near the point where the road emerges into the grassy zone (Pinchot Exped., July 4, 1929).

This form stands close to *P. macneilli* Clapp, of Alabama. It has a noticeably larger, more open umbilicus (compare Pl. 16, fig. 8, *galapagorum,* and fig. 5, *macneilli*) and a higher spire, and the growth wrinkles are *decidedly stronger* in the Galapagos species.

PUPISOMA COMICOLENSE H. B. Baker. Plate 15, fig. 6.

Shell: small, turbinate; epidermis light brownish with a satin luster. Whorls: 4½, globose; suture well impressed; last whorl descending. Embryonic whorls: 1¾ to 2, darker in color than later ones; decorated with minute, raised tessellation, which gives surface the appearance of fine-grained leather; growth-wrinkles emerge near end of second whorl. Later whorls: growth-wrinkles weak and low over most of shell, but slightly intensified at suture, giving latter a puckered appearance (occasional specimens develop a few higher riblets); entire surface vermiculate-granose, without definite spirals. Umbilicus: small, rimate (about 14 times in maj. diam.). Aperture: well rounded and oblique (about 40° to long axis of shell). Peristome: very weakly expanded in basal and palatal regions and weakly arcuate in latter; broadly reflected in columellar, so that half of umbilicus is hidden (*H. B. B.*).

Alt. 2.19 mm., maj. diam. 85 per cent of alt. (1.87 mm.), min. diam. 80(1.76 mm.), aperture, alt. 46(1.00 mm.), diam. 96(.96 mm.); 4½ whorls.

Mexico, Estado Puebla: Necaxa, 2625-3800 ft.; mainly below the falls, common on leaves of shrubs and trees (H. B. Baker).

Pupisoma comicolense H. H. B., Proc. Acad. Nat. Sci. Philadelphia 79: 224, pl. 15, f. 4-7, 1927, anatomy only; Occ. Pap. Mus. Zool. Univ. Mich. No. 220, Oct. 15, 1930, p. 3, pl. 7, f. 1, 2, shell.

P. comicolense is about the size of *P. dioscoricola* (C. B. Ad.), but with one more whorl, is relatively and actually higher. Its sculpture is most like that in *P. minus* Pilsbry, but *P. comicolense* is far larger and has a relatively much smaller umbilicus and higher whorls with better impressed suture. Although it occurs with *P. mediamericanum,* the latter is most abundant in lower vegetation and at higher altitudes (*H. B. B.*).

PUPISOMA BAILYI, n. sp. Pl. 24, fig. 15.

The shell is umbilicate, globose-conic, the apex very obtuse, cinnamon colored, of 3½ strongly convex whorls, the first minutely and weakly pitted, the rest with some wrinkles of growth, unevenly developed, and a very shallow and minute pitting. Aperture rotund-truncate, the peristome thin, columellar margin broadly reflected. Length 1.95 mm., diam. 1.8 mm.

Mexico: Cuernavaca, State of Moreles; type 156099 A. N. S. P., collected by Joshua L. Baily, 1931.

This equals in size the largest *P. dioscoricola,* and is of a more conic shape. It is larger, darker colored and more conic than other Mexican species.

PUPISOMA ORCULA (Bens.). Vol. 26, p. 31.

Reported from the island of Makatea by C. M. Cooke, Jr., Occ. Pap. B. P. Bishop Mus. vol. 10, No. 11, pp. 4, 8. He considers it one of several species introduced by man.

ACANTHINULA (Vol. 27, p. 188).

ACANTHINULA ACULEATA (Müll.). Vol. 27, p. 191.

The original reference for *Helix nucleata* (p. 192) is Turton,

A General System of Nature, etc., vol. 4, 1802, p. 520. He referred to accounts of *aculeata* by Müller and Chemnitz. *Cf.* Cockerell, Nautilus, vol. 40, July, 1926, p. 31.

ANTHRACOPUPA (Vol. 27, p. 316).

Add: *Anthracopupa britannica* L. R. Cox, Ann. Mag. Nat. Hist. (9), vol. 18, 1926, p. 168. Carboniferous, Keele Beds, Clent Hill, Worcestershire.

Ptychospira deloplecta Slavik, Vol. 27, p. 264, is said to be a scalariform shell of *Planorbis declivis* Al. Braun, which Wenz ranks as a synonym of *Gyraulus trochiformis applanatus* (Thomae). (Petrbok, Acad. Tchèque des Sciences, Bull. Internat. XXVI, 1925, p. 192, figs. 4-6. 1926). *Ptychospira* thus becomes a synonym of *Gyraulus* (Planorbidae).

GASTROCOPTA Woll. (Vol. 24, p. 6).

Gastrocopta pellucida hordeacella (Pils.). Pl. 22, fig. 7.

Specimens from Mojave Mt., California, are long and cylindric, with the lower-palatal fold of unusual length, and the basal fold either small or wanting; crest obsolete.

Length 2.6 mm., diam. 0.95 mm.

Length 2.25 mm., diam. 0.9 mm.

S. S. Berry has figured similar specimens from Palm Canyon, San Gabriel Mts., California (Proc. A. N. S. Phila. 1922, p. 97, figs. 1-4).

Gastrocopta wolfii (Miller). Vol. 24, p. 94.

Add to synonymy: [*Pupilla*] *reibischi Dall,* 1917, Proc. Biol. Soc. Washington, vol. 30, p. 10. Not *Pupilla* (*Gastrocopta*) *reibischi* Dall, 1928, = *G. munita brunnea* Pils.

Gastrocopta ashmuni imperfecta Pils. & Ferr.

The columellar lamella is simply curved within, and outwardly remains horizontal, as in *G. cochisensis,* not passing into the position of an infraparietal lamella. Peristome more or less free or continuous. The very large angulo-parietal

lamella and the very deeply immersed lower-palatal fold remain as in *G. ashmuni.*

Arizona: Huachuca and Mustang Mountains. Type 162445 A. N. S. P., coll. by *J. H. Ferriss.*

Gastrocopta ashmuni imperfecta P. & F., Proc. A. N. S. Phila. vol. 75, 1923, pp. 62, 63.

GASTROCOPTA PILSBRYANA AMISSIDENS, new subsp. Pl. 24, figs. 5, 6.

The shell is like the typical form except that there is no basal fold. Sometimes the upper-palatal fold also is wanting. Type 161437 A. N. S. P., from the San Francisco Mountains, Arizona, collected by J. H. Ferriss. It also occurs at Mahan Mt. near Mormon Lake, about 20 miles south of Flagstaff, Arizona, and eastward at the Betatakin ruins, and in New Mexico at Golden, Santa Fé Co. It is therefore rather widely distributed in northern Arizona and New Mexico.

GASTROCOPTA PEDICULUS (Shuttl.). Vol. 24, p. 158.

Bifidaria bannertonensis C. J. Gabriel, 1930, Proc. Roy. Soc. Victoria, vol. 43, p. 64, pl. 3, figs. 9, 10, appears, from topotypes received from Mr. Gabriel, to be completely identical with *G. pediculus*; but his record extends the known range of the species far southward. The original description follows, with photographic copies of the original figures. Plate 21, fig. 13.

"Shell minute, white, dextral, attenuate, narrowly umbilicate. Apex obtuse. Whorls 5, convex, ornamented by numerous impressed growth-striae. Sutures deeply impressed. Aperture roundly oblong, armed with five white teeth; one situated about center of parietal wall, comparatively large and unequally bifid; three placed within the basal and outer margin, the center of which is most prominent; the fifth on the columella. Peristome expanded; the columellar expansion partly concealing the narrow umbilicus. Size of type: length 2.6, breadth 1.3 mm." (*Gabriel*).

Bannerton [Victoria, Australia] (*A. C. Nilson*).

"Few species have been described from Australia, and the present is the first representation of the genus in Victoria. In general arrangement the dentition is fairly constant, but specimens have been examined showing the teeth a trifle stronger. As regards measurements the species is subject to variation, the paratype figured being 2.3 x 1 mm. *Pupa larapinta* Tate and *P. mooreana* Smith, from Central Australia, bear some resemblance, but may be distinguished by their broader contour and more convex whorls" (*Gabriel*).

In view of its wide distribution, my suggestion (Vol. 24, pp. 158-9) that *G. pediculus* was imported into New South Wales within the human period, seems improbable though not impossible. It may be a very old and conservative species which reached Australia in the Pliocene. If *Pupa margaretae* Cox, from Wallaroo, South Australia, is also *pediculus*, its range will be further extended. New collections at that place will be required to settle this point, as the type of *margaretae* seems to be lost.

In 1923 I found *pediculus* abundant at Tweed Heads, Rous Co., N. S. Wales, and the var. *queenslandica* in Brisbane, Queensland.

GASTROCOPTA NIOBE (Fulton). Pl. 22, fig. 2.

Man. Conch. vol. 24, p. 153; vol. 27, p. 209. Tenimber Is.

Mr. Fulton has been so good as to send a paratype specimen which he compared with the type in Brit. Mus., and which is here illustrated, pl. 22, fig. 2. As I noted in vol. 27, it is identical with the later *G. moellendorffiana* Pils., 1917, from Bohol, M. C. vol. 24, p. 145. The description given on p. 145 applies fully to this paratype, which measures, length 1.9 mm., diam. above aperture 1 mm. It will be seen that it bears little resemblance to the original figure and description of *P. niobe*; the species could never have been identified by them; but it serves to illustrate the difficulties which beset a monographer of the Pupillidae. Many of the descriptions and figures of minute species are misleading.

G. niobe belongs to the subgenus *Sinalbinula*.

Subgenus CAVIPUPA, n. subg.

The shell is broadly and deeply umbilicate, of few, strongly convex whorls; apertural teeth as in *Gastrocopta s. str.*, the basal fold subcolumellar in position. Type *G. euryomphala.*

In the last whorl the diameter of the columellar axis is contained about three and a half times in that of the shell. It tapers rapidly upwards (Pl. 22, fig. 3). By the open umbilicus this group resembles the American genus *Chaenaxis*; both were doubtless derived from the typical group of *Gastrocopta*, but of course independently.

GASTROCOPTA EURYOMPHALA, new species. Pl. 22, figs. 3, 4, 5, 6.

The shell is thin, whitish (dead), widely and deeply umbilicate, conic, composed of 4½ very convex whorls, the penultimate whorl bulging very conspicuously, the last whorl becoming flattened peripherally in its last half, and marked with a short groove over the position of the lower-palatal fold; without swelling or crest behind the outer lip. Suture very deep. Sculpture of microscopic granulation on the first whorl, the later whorls with fine, somewhat uneven growth striae. The aperture is shortly oval, with rather thin, broadly expanded and continuous peristome, the upper margin either free or shortly adnate to the preceding whorl. Parietal lamella straight and rather strong; angular lamella short, uniting with the parietal at the front third of the length of the latter. Columellar lamella median, strong, turning down a little at its inner end. Lower-palatal fold strong, elongate, the upper-palatal and basal folds tuberculiform.

Length 2.2 mm., diam. 1.3 mm. Type.

Length 2.1 mm., diam. 1.3 mm.

Philippine Islands: Bintuan, Busuanga. 160431 A. N. S. P. (Quadras).

The large umbilicus and conspicuously convex whorls distinguish this from all other known Philippine species. The specimens were received through Mr. Walter F. Webb, without name, but I think that they are without much doubt the species which von Moellendorff called *Leucochilus eury-*

omphalum (Abhandl. Naturf. Ges. Görlitz, vol. 22, p. 153; 1898) from Tangat, Busuanga, and which, as I noted in vol. 24, p. 141, seems not to have been described.

FAUXULUS Schauf. (p. 73).

FAUXULUS FRYANUS (Bens.). Pl. 21, fig. 14.

Vol. 24, p. 246. "As this almost unknown species has never been figured, I illustrate an example in my collection gathered by Layard at Bredasdorp. The aperture is tubular and particularly remarkable for the basal canal, which continues as a sharp, strong keel around the wide, deep umbilicus, while, owing to the apertural prolongation, two of the lamellae are so deepset as to be hardly visible; the sculpture also is remarkable, consisting after the first two whorls of close, coarse, curved oblique costae, which are cut from the sixth whorl onward by particularly strong, close, spiral grooves. The pale lilac hue of the lower whorls is another unusual feature" (*Connolly*, Ann. Mag. N. H., 10 ser., vol. 8, p. 308, pl. 10, fig. 11).

FAUXULUS BARNARDI Connolly. Pl. 21, fig. 4.

"Shell sinistral, rather small, subfusiform, rimate, slightly silky, rather glossy, corneous reddish-brown. Spire produced, sides convex, apex mammillate. Whorls 8, not very convex, increasing very gradually until the last, which is narrower than the one before it; the first smooth, remainder sculptured with close, fine, slightly curved, oblique striae; suture simple, well defined. Aperture subquadrate, peristome just free, expanded and continuous; lips vertical in profile; dentition 7-fold: a strong, slightly incurved, inrunning parietal lamella, arising in the central of the paries; a similar angular lamella arising on the edge of the labrum; two blunt denticles, the lower slightly larger, close together half-way down the labrum; a strong, inrunning lower-palatal fold; a small tubercle about the center of the base, and a very prominent, descending, inrunning columellar lamella" (*Connolly*).

"Long. 4.7, lat. 2.6; apert. alt. 1.7, lat. 1.7; last whorl 2.2 mm."

South Africa: Keurboom River Bush, Cape Province (*Barnard*).

Fauxulus barnardi CONNOLLY, Ann. Mag. N. H. 10 ser., vol. 8, p. 309, pl. 10, fig. 5. Oct., 1931. Type in South African Museum.

"Three examples, all mature and alike. While bearing no resemblance whatever to *F. capensis, burnupianus, pamphorodon, fryanus,* or the dextral *layardi* and *crawfordianus,* they are easily distinguishable from *falconianus, mcbeanianus, glanvilleanus, ponsonbyanus* and *pereximius* by having only a single process on the columella, whereas the others have two or more" (*Connolly*).

ABIDA (Vol. 27, p. 267).

J. B. de Aguilar-amat has given a sketch of the life of Artur Bofill i Poch, with portrait and a bibliography of his malacological works, prefatory to his catalogue of Pupillidae in the Museum of Barcelona, in Treballs del Museu de Ciències Naturals de Barcelona, vol. 10, No. 4, 1932. The following forms, named but not published by Bofill, are illustrated, the figures reproduced photographically on our Plate 20. No descriptions are given.

ABIDA POLYODON MONTSERRATICA forma *monsjovica* Bofill, MS. Pl. 20, fig. 1. Montjuic, Prov. de Barcelona, Spain. (D'Aguilar-amat, l. c., p. 18, pl. 1, f. 1).

ABIDA POLYODON MONTSERRATICA forma *vidali* Bofill, MS. Pl. 20, fig. 3. Hostel Roig, Prov. de Lleida, Spain (D'Aguilar-amat, l. c., p. 18, pl. 1, f. 2).

ABIDA BRAUNIOPSIS Bofill, MS. Pl. 20, figs. 8, 8*a*. Gòsal, Prov. de Lleida, Spain (D'Aguilar-amat, l. c., p. 19, pl. 1, f. 5).

ABIDA CATALONICA VALIDA Bofill, MS. Pl. 20, fig. 2. Montgrony, Prov. de Barcelona, Spain (D'Aguilar-amat, l. c., p. 22, pl. 1, f. 2).

CHONDRINA (Vol. 27, p. 283).

CHONDRINA AVENACEA SUBCORNEA Bofill, MS. Pl. 20, fig. 12. Montferrand, Aude, France (D'Aguilar-amat, l. c., p. 27, pl. 1, f. 6).

CHONDRINA BIGORRIENSIS TENUIMARGINATA forma MACROCHILUS Bofill, MS. Pl. 20, fig. 11. Hospitalet de l'Infant, Prov. de Tarragona, Spain (D'Aguilar-amat, l. c., p. 32, pl. 1, f. 9).

CHONDRINA BIGORRIENSIS TENUIMARGINATA forma FLACCIDA Bofill, MS. Pl. 20, fig. 10. Castejon de Sos and Pont de Neu d'Astos, Prov. d'Osca, Spain (D'Aguilar-amat, l. c., p. 32, pl. 1, f. 8).

CHONDRINA DERTOSENSIS FARTA Bofill, MS. Pl. 20, fig. 13. Hifac, Prov. d'Alacant, Spain (D'Aguilar-amat, l. c., p. 33, pl. 1, f. 4).

SOLATOPUPA SIMILIS MONTEROSATOI Bofill, MS. Pl. 20, fig. 9. Castel Gandolfo, Massa Carrara, Italy (d'Aguilar-amat, l. c., p. 35, pl. 1, f. 7).

Solatopupa thieuxi Locard, from Correns, Var, France, was mentioned by d'Aguilar-amat, l. c., p. 35, without description. So far as I know it has not been defined.

ORCULA (continued from p. 93).

Dr. Stephan Zimmermann has published a critical study of great merit, "Ueber die Verbreitung und die Formen des Genus *Orcula* Held, in den Ostalpen" in Archiv für Naturgeschichte, n. ser. 1, 1932, pp. 1-56. In order that all names proposed up to the end of 1933 may appear in the Manual, the following much abbreviated notes are compiled; his figures are reproduced. Those concerned with Alpic Orculae will of course consult Zimmermann's paper.

In the discrimination of forms below the rank of species great weight is placed upon dimensions of the shell; but this is never the measurements of single specimens, but the average of an entire population. In ascertaining this the length and breadth of 20 or 30 shells from one place are measured and the mean taken; the maximal and minimal records being also noted.

A synopsis of the forms treated follows. It will be noticed that four categories are recognized: species, subspecies, forms and morphs. The distinction between *forma* and *morpha* in

this connection is not clear to me; but I presume that *morpha* is applied to populations having characters not thought to be of racial significance, but denoting changes presumably resulting from environmental influence, such as are correlated with elevation, aridity and the like. In Zimmermann's descriptive text the names of both forms and morphs are written as trinomials, as in the abstract following the table.

ORCULA DOLIUM Drap.	morpha *dolium*, s. str.
" "	morpha *infima*, n. m.
" "	morpha *edita*, n. m.
" "	morpha *oreina*, n. m.
" "	forma *pseudogularis* A. J. W.
" "	forma *gracilior*, n. f.
ORCULA DOLIUM Drap. intermediate with GULARIS Rssm. (*O. gularis pseudodolium* A. J. Wagner)	
ORCULA GULARIS Rssm. subsp. GULARIS Rssm.	morpha *gularis* s. str.
" " " "	morpha *oreina*, n. m.
" " " "	RESTITUTA West.
ORCULA DOLIUM intermediate with TOLMINENSIS A. J. Wagn.	
ORCULA TOLMINENSIS A. J. Wagner.	
ORCULA SPOLIATA Rssm. subsp. SPOLIATA Rssm.	
" " "	AUSTRIACA, n. subsp.
	morpha *austriaca* s. str.
	morpha *oreina*, n. m.
ORCULA FUCHSI St. Zim.	
ORCULA CONICA Rssm.	forma *conica* s. str.
" "	forma *minor*, n. f.

ORCULA DOLIUM DOLIUM (Drap.). Text-figs. 1-6.

The fundamental form has as a rule two equally strong and nearly equally emerging columellar lamellae. Among them there are almost always single examples with the upper lamella somewhat weaker. A third, middle columellar lamella, somewhat weaker (aberration *triplicata*) occurs not rarely as a purely individual hyperplasy, almost entirely in large

shells. The diam. is from 3 to 3.4 mm., length 6.8 to 8 mm.; some specimens occur above and below these dimensions.

ORCULA DOLIUM INFIMA St. Zim. (*l. c.* p. 14). Text-fig. 7.

The largest of the species, up to length 9.1 diam. 4.1 mm., with 9 to 10½ whorls. Southern and eastern parts of the Wiener Wald. It is very similar to the Carpathian (Bad Trencsin-Teplitz) *O. d. titan* Brancsik [vol. 27, p. 9].

ORCULA DOLIUM EDITA St. Zim. (*l. c.* p. 17). Text-fig. 8.

Smaller, more cylindric than the typical form, diam. between 2.8 and 3 mm., length 6.7 to 7.3 mm. Palatal callus and generally the peristome strongly developed. *The upper columellar lamella is always weaker than the lower*, sometimes almost obsolete. This is the form of the middle heights of the subalpine region to the limit of trees. The most characteristic state of this morph is from the southern slopes of the Schneeberg massif; also found in some heights of the northern Tirol and Bavarian Alps, and in some places far down in the valleys. *O. d. uniplicata* Pot. and Mich. apparently belongs in the *formenkreis* of this morph, but no recent author has seen the type. *O. d. plagiostoma* Sandb. (Man. Conch. vol. 27, p. 11) is also to be considered in this connection. "I would confirm that the *plagiostoma* of the Danube valley, which I know from the loess at Passau, from Pielachberg at Melk, in the Wachau, and from Nussdorf and Heiligenstadt near Vienna (fig. 9), agree in measurement, external shape and apertural characters with the forms which live today in heights between 1000 and 1600 meters in the Niederösterreichisch-Steirischen Kalkalpen."

ORCULA DOLIUM OREINA "A. J. Wagn." St. Zim. (*l. c.*, p. 20). Text-fig. 10.

The shells are still smaller throughout than the morph *edita*. The average dimensions are: diam. 2.6 to 2.8 mm., length 6.2 to 6.7 mm.; whorls 8 to 9. They are thick-shelled and strongly rib-striate; the aperture is small and the palatal callus generally stronger than in *edita*. The reduction of the columellar

Explanation of Figures 1 to 20.

Fig. 1, *Orcula dolium* Drap., Reutte, Nordtirol, 860 meters. 2, Unteres Bärenthal bei Feistritz, Karawanken, about 530 m. 3, Emberg bei Kapfenberg, Nordoststeiermark, about 500 m. 4, R. Pfannberg bei Frohnleiten, Steiermark, 530 m. 5, Merkenstein bei Baden, Niederösterreich, 500 m. 6, conic shells, Mariaschutz bei Schottwien, Semmeringgebiet, about 700 m.

Fig. 7, *Orcula dolium infima* St. Zim., Kierling bei Klosterneuberg, Niederösterreich, 220 m.

8, *O. d. edita* St. Zim., Schneeberg: eng bei Reichenau, Niederösterreich, 1100 m.

9, *O. d. plagiostoma* Sandb., Loess von Pielachberg bei Melk, Niederösterreich, 230 m.

10, *O. d. oreina* St. Zim., Rax: Heukuppe, Niederösterreich-ischsteirische Grenze, 2009 m.

11, *O. d. pseudogularis* Wagn., R. Türkensturz, Pittental, Niederösterreich, 480 m.

12, *O. d. gracilior* St. Zim., Adlitzgraben bei Schottwien, Semmeringebiet, 660 m.

13, *O. dolium* + — *gularis* (*gularis pseudodolium* A. J. Wagn.), Unteres Reichramingbachtal bei Reichraming, Oberösterreich, 400 m. Fig. 14, Hänge der Wildgrabenklause bei Reichraming, 600 m. Fig. 15, Lainautal, Südfuss des Traunstein bei Gmunden, Oberösterreich, 800 m.

16, *O. gularis* Rssm., Klein Hollenstein, Ybbstal, Niederösterreich, about 490 m. 17, Ennstal bei Hieflau, Steiermark, 490 m. 18, Nordseite des Loiblpasses, Karawanken, about 1000 m.

19, *O. gularis oreina* St. Zim., Grosser Buchstein, Gesäuse, Stiermark, 1800 m.

20, *O. gularis* aberration *reducta* St. Zim., Nordwesthänge des Spitzkofel bei Lienz, Osttirol, about 1700 m.

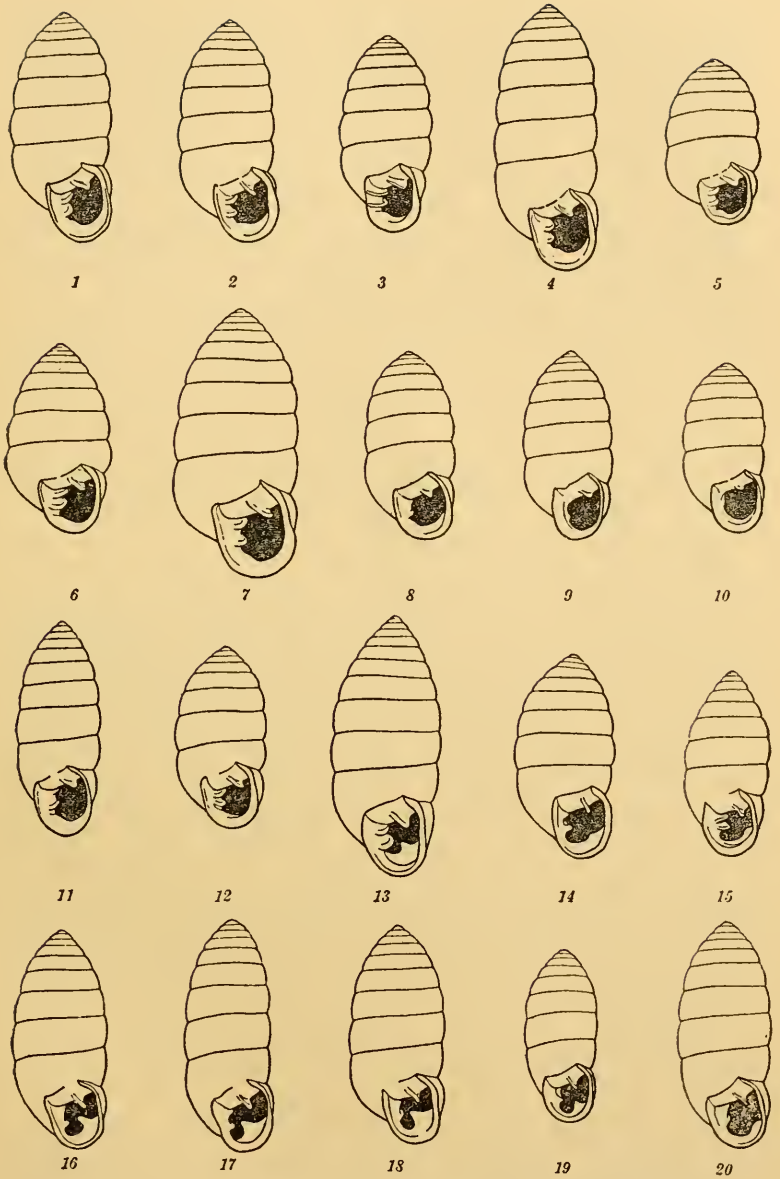


Fig. 3 (1 to 20). Orcula in the Eastern Alps (after S. Zimmermann).

lamellae has gone further: the lower lamella is weak and not rarely represented by a short, low little ridge far within, occasionally wanting. As a rule the upper lamella is wanting; only seldom a small vestige remains. The smallest examples of this form I have from the Heukuppe, 2009 meters, the highest point of the Rax. Width 2.5 mm., length 5.6 to 5.7 mm. (fig. 10). *O. d. oreina* is confined to the subalpine zone of the highest elevations of the northern Dolomites and reaches about to the tree limit, thus upward generally to 1600 meters, at its lower limit gradually merging into the form *edita*.

ORCULA DOLIUM PSEUDOGULARIS A. J. Wagner (vol. 27, p. 11). Text-fig. 11, is a local form of the metamorphic Mesozoic rocks of the Türkensturz, Gleissenfeld in the Pittental, lower Austria. Wagner's measurements are erroneous. The average length is 7.2 mm. single specimens up to 8 mm., none over 3 mm. wide. The medium breadth is 2.7 mm., the slenderest 2.6 mm., only a few reaching 3 mm. wide.

ORCULA DOLIUM GRACILIOR St. Zim. Text-fig. 12.

The dimensions of this form are strikingly constant, its medium being for length 6.3 to 6.8 mm., for width 2.8 to 3 mm.; the diameter being that of *edita*, but the length somewhat less. A conspicuous difference from *edita* is in the columellar lamellae which wholly resemble those of typical *dolium* and are even more regular than in that, strong and equally developed. Thus out of 40 from one place in the Adlitzgräben on the Semmerling, only three have the upper lamella weaker than the lower (fig. 12). It is a miniature of *dolium*. It inhabits a restricted district of the eastern border of the Alps, from the slopes of the Sonnwendstein and the Semmering in lower Austria in a northwestern direction about to Gloggnitz.

Zimmermann is disposed to view *pseudogularis* and *gracilior* as modified subalpine enclaves of *O. d. edita*.

ORCULA DOLIUM Drap. intermediate with GULARIS Rssm. (*O. gularis pseudodolium* A. J. Wagner, vol. 27, p. 14). Text-figs. 13, 14, 15.

This form is one of the most remarkable of the genus *Orcula*. Its morphologic peculiarity lies in the manifold combination of the characters of two species, *O. dolium* and *O. gularis*. Its relation to these can be interpreted as due to a secondary mixture, or to the survival of an undifferentiated stock in this part of the northern Dolomites, representing a stage at the beginning of the evolution of the two species, which elsewhere show no intergradation. The former hypothesis is more probable, that is, that these forms are the progeny of an actual mixture of the two species. It inhabits part of the upper Austrian Alps, bounded on the west by the Traunsee and in the east by the valley of the Enns.

ORCULA GULARIS (Rssm.). (Vol. 27, p. 13). Text-figs. 16, 17, 18.

This species is confined to the eastern Alps; forms so labelled from the Carpathians seen are nothing else than slender forms of *O. dolium*. "True montane forms are before me from few places. Those collected on the northern slopes of the Duerrenstein near Lunz (lower Austria) in about 1500 meters afford average measurements of from 5.7 x 2.45 mm.; on the Grossen Buchstein in 1700-1800 meters, 5.8 x 2.5 mm. The shells are in general somewhat thicker and more strongly rib-striate, the folds of the aperture, especially the parietal, weaker. This is forma *O. gularis oreina* St. Zim. (fig. 19).

ORCULA GULARIS RESTITUTA (Westerl.) (Vol. 27, p. 14). Text-figs. 21, 22.

This form does not differ from *O. gularis* proper in external form or dimensions,—width 2.7 to 2.8 mm., length 6.3 to 6.5 mm. The columellar lamellae are of equal strength, lie rather close together, and reach equally far, quite to the sharp edge of the peristome. The palatal callus is mainly very delicate, not rarely lacking entirely, but it is also often quite strongly developed, and then shows, near its outside limit, a little prominence, which however has nothing in common with the rudiment of a palatal fold; *the latter being wanting* in all cases (figs. 21, 22). St. Annatale south of the Loiblpasse, etc.

Explanation of Figures 21 to 42.

21, *Orcula gularis restituta* West., Feistritztal bei Stein, Steiner Alpen, 390 m. 22, Südhang der Velka Planina oberhalb St. Primus, Steineralpen, 950 m.

23, *Orcula gularis* + — *tolminensis* A. J. Wagn., Dachstein-Südseite: Rabenkögel, Steiermark, 1270 m. 24, Zaghalswände, Steiermark, 1850 m.

25, *O. tolminensis* A. J. Wagn., Strasse zwischen Hallstatt und Gosaumühl, Oberösterreich, 500 m. 26, Kuppitzklamm bei Eisenkappel, Karawanken, about 700 m.

27, *O. spoliata* Rssm., Valdagno bei Vicenza, Lessinische Alpen, about 270 m. 28, Fennberg bei St. Margreid im Etschtal, Südtirol, 1000 m. 29, Oberhalb S. Romedio im Val de Non, Südtirol, about 950 m.

30, *O. spoliata austriaca* St. Zim., Lilienfeld, Niederösterreich, 400 m. 31, Hohe Wand bei Wiener Neustadt: Springelsteig, Niederösterreich, 700 m. 32, Schwartzau im Gebirge, Schneeberggebiet, Niederösterreich, 620 m.

33, *O. spoliata austriaca oreina* St. Zim., Göller, Niederösterreich, 1750 m.

34, 35, *O. fuchsi* St. Zim., Turmmauer, Nordhang des Göller, 750 m. 36, Waldhüttsattel südlich von Kernhof, Niederösterreich, 1200 m.

37, *O. conica* Rssm., Koranatal bei Plitvice, Kapellengerbirge, Südkroatien, 520 m. 38, Loibltal, Karawanken, about 600 m. 39, Oelgraben im unteren Lavanttal, Kärnten, about 450 m.

40, *O. conica minor* St. Zim., Gurnitzer Schlucht, Satnitz, Kärnten, about 490 m.

41, *O. dolium* + — *conica* ? Grosser Suhagraben bei Maria Elend, Karawanken, about 800 mm. 42, Windischbleiberg, Karawanken, about 950 m.

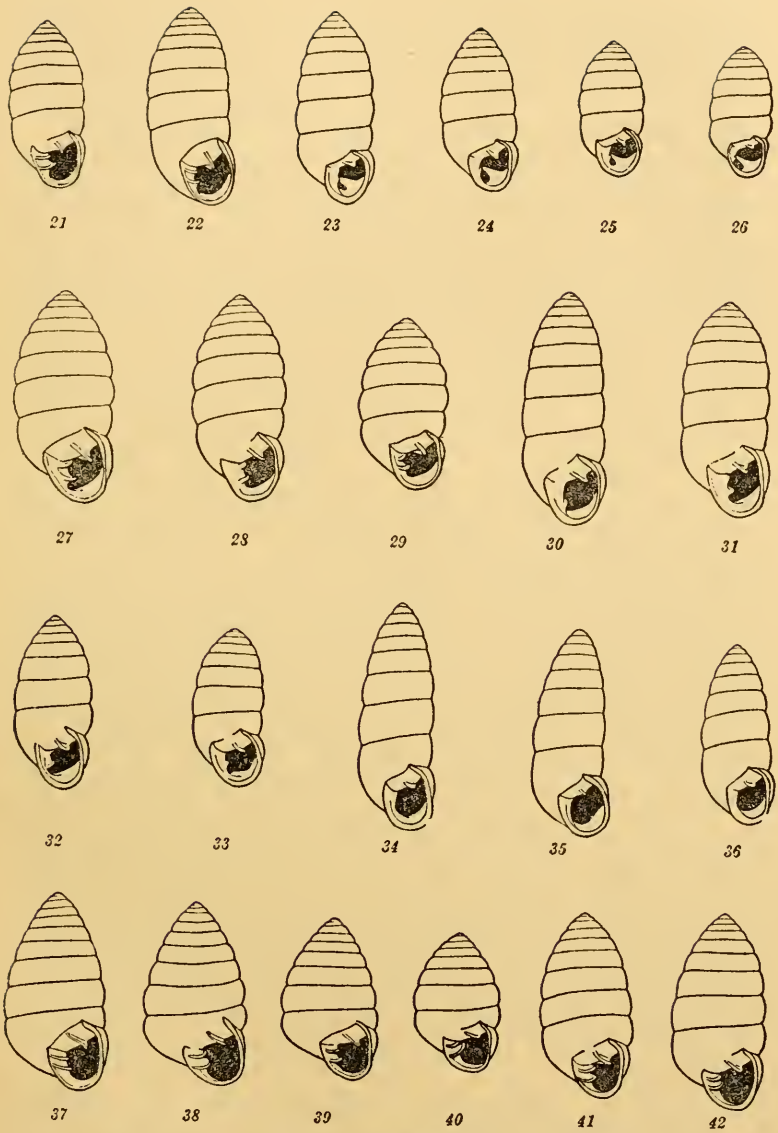


Fig. 4 (21 to 42). Orcula in the Eastern Alps (after S. Zimmermann).

ORCULA TOLMINENSIS A. J. Wagner. (Vol. 27, p. 16). Text-figs. 25, 26.

ORCULA SPOLIATA (Rssm.) (Vol. 27, p. 14). Text-figs. 27, 28, 29.

ORCULA SPOLIATA AUSTRIACA St. Zim. Text-figs. 30, 31, 32.

The habitat of this species, of which I have material from more than 60 localities, comprises the eastern part of the northern Dolomites. It differs from *O. spoliata spoliata* in dimensions; it is constantly more slender. The average length lies between 6 and 7 mm., the breadth between 2.6 and 2.8 mm.; a further difference is that the whorls are less convex and the suture shallow; only the last whorl is somewhat swollen. Whorls 9-10½. The columellar lamellae are often weaker than in the typical race, the upper always weaker than the lower, and not rarely indicated by only a delicate ridge of the columellar wall. The strongly entering palatal callus is common to both forms, but in *austriaca* is rather more strongly developed (figs. 30, 32).

At high elevations it is smaller. On the Göller in lower Austria at an elevation of 1750 meters, as well as on the Rax plateau (Gsollhirn) at height of 1540 meters there is a true high region form, 5.5 x 2.5 mm. The shells are thicker, palatal callus rather stronger; parietal and lower columellar lamellae are weaker, while the upper columellar lamella is not perceptible. This is *O. s. austriaca* morpha *oreina*, Text-fig. 33.

ORCULA FUCHSI St. Zim. (This vol. p. 89). Text-figs. 34, 35, 36.

ORCULA CONICA (Rssm.). (Vol. 27, p. 15). Text-figs. 37, 38, 39.

The distribution of this species comprises the extreme southeast of the Alps and the contiguous Dinaric mountains, therefore chiefly the Karawanken Julischen and Steiner Alpen and the elevations southeastward of these mountains including the Kapellen mountains. Nearly all localities are upon Mesozoic limestone.

The average dimensions are: length 6 to 7 mm., diam. 3 to 3.5 mm. Though smaller specimens occur anywhere in its area, they are constant in a few places in the Satnitz

(Gurnitzer Schlucht and in a Schlucht of the Windachwald). The shortly conic shells there have average size of 5.4 x 2.95 mm. This is *Orcula conica minor*, new local form, H. von Gallenstein *in schedis* (fig. 40).

Among typical *conica* from two places in the Karawanken (Grosser Suhagraben bei Maria Elend and Windischbleiberg) there are specimens standing midway between the two species in being more cylindric than typical *conica* and more conic than typical *dolium*, with a weakly labiate peristome and two thin, equally strong columellar lamellae reaching to the edge of the peristome (as occurs exceptionally in *O. dolium*); so that it seems impossible to refer them with certainty to either species (text-figs. 41, 42). The number in each place is very small. Can it be that there are transitions between *O. dolium* and *O. conica*?

ORCULA DOLIOLUM (Brug.) var. (Vol. 27, p. 17).

Valley of the Vantsch River, Darvaz, Pamir (Kaznakov). "These specimens agree with those of middle Europe in size and sculpture and differ from them only in that the shell is quite cylindric (not broader above), and that the two columellar lamellae are more weakly developed and not visible in a direct front view in the mouth. Wholly similar are many specimens from Transcaucasia. The species has been reported for Central Asia (Rosen, 1901) and is known from various places in the mountainous part of Turkestan. It has been recorded from Kopet-Dag in Transcaspia, Baron O. von Rosen, and from north Persia (O. Boettger 1898), so that it is easy to make the connection with its occurrence in Transcaucasia and Asia Minor. It is well known to extend thence over cis-Caucasia (Retowski, 1914) and the Crimea (Lindholm 1926) to southeastern and middle Europe. It is a pronounced mountain dweller" (*Lindholm*, 1931, Abhandlungen der Pamir-Expedition 1928, VIII, p. 43).

ORCULA TOMLINI Connolly. Pl. 21, fig. 12.

"Shell small, cylindrical, rimate, thin, silky, translucent, corneous brown. Spire produced; sides straight and parallel,

summit (4 whorls) bluntly conic. Whorls 8, almost flat, gradually increasing; protoconch (1¾ whorls) engraved to the apex with close, regular, microscopic spiral grooving, remainder sculptured with fairly close and regular, slightly curved and oblique transverse striae. Suture simple, shallow. Aperture subquadrate, rounded at the base; peristome white, glossy and reflexed. Dentition 7-fold: an acute, deeply inrunning lamella on the center of the paries, with two large, rounded tubercles, thickening outwards in the direction of, but not touching, the ends of the peristome; two prominent inrunning lamellae, arising on the outer margin of the columellar lip, one-half and three-fourths way up the columella, and two narrower ones deepset above them; columella erect, margin rather narrowly reflexed'' (*Connolly*).

''Long. 6.3, lat. 2.7; apert. alt. 1, lat. 1; last whorl 3.5 mm.''

Tripoli: Cyrenaica north of Merj (*J. W. Gregory*).

Orcula tomlini Connolly, Ann. Mag. N. H., 10 ser., vol. 8, p. 305, pl. 10, fig. 1. Type in Tomlin collection.

''Two specimens, the second measuring 6 mm. in length and lacking one of the smaller immersed lamellae at the top of the columella. The feature which appears to separate this species from all other known *Orculae* is the presence of the small tumuli on the paries; they are exactly similar in both examples, and can hardly represent an ordinary callous process, since, despite their size, they neither connect with the parietal lamella nor with either end of the peristome. Something of this kind is present on *O. orientalis* var. *nitida* Mouss. and *O. moussoni* Reinh., both from Aleppo, but the tubercles are smaller and are connected with the margins. In *Orcula tomlini* the two lower columellar lamellae are extremely conspicuous.

''I have much pleasure in naming this beautiful species in honor of its owner, in grateful recognition of the courteous and ever-ready help and advice in many branches of science, for which countless students besides myself are indebted to him'' (*Connolly*).

OF UNCERTAIN POSITION.

"PUPA" LATA C. B. Adams. Pl. 21, fig. 15.

See vol. 27, p. 246, where the original description of this species is repeated, and it was referred with a mark of doubt to the genus *Columella*. The unique type is here figured. It is imperforate, yellowish corneous, slightly translucent, very shortly cylindric with conic summit. The high first half-whorl is smooth, the rest delicately costulate, the riblets low, very narrow with wide intervals, stronger on the upper part of the spire, on the last whorl stopping abruptly at the weak angulation which bounds the smooth, rather flattened base. There are nearly 4 rather strongly convex whorls. The aperture is oblique. Peristome is not in the least expanded and is thick for so small a shell, its edge smoothly rounded. Columella with an indistinct, closely adnate reflection above. Length 1.9 mm., diam. 1.35 mm.

It differs from *Pupisoma* and *Columella* by the smoothly rounded finish of the lip, and the columella. The riblets are not cuticular. I take it to be the embryonic stage of some larger shell, but I have not been able to trace the species. It is not a pupillid snail, in my opinion. No locality further than "Jamaica" is known.

PUPILLA (Vol. 26, p. 152).

PUPILLA CUPA (Jan). Vol. 26, p. 185.

A study of the specimens in the Charpentier collection has been made by G. Mermod (Revue Suisse de Zool., vol. 33, No. 17, July, 1926, pp. 577-582).

The types of *Pupa alpicola* Charp., two specimens from Mont Giétroz near Fiomay, valley of Bagnes, Valais, are figured, his figures reproduced in our Pl. 24, fig. 11.

Pupa halleriana Charp. agrees with *P. cupa*, the only distinction mentioned by Charpentier being the presence of fine granulation on the shell. In certain lights such microscopic granulation occurs in the majority of the shells of *muscorum*, *sterri* and *triplicata*.

M. Mermod concludes that "the specific value of *P. alpicola, halleriana, madida* and *muscorum* var. *pratensis* seems to me very doubtful. I think that, without risk of gross error, all these names can be put in synonymy and considered to form simply a variety of *P. muscorum.*" The synonymy, in this view, will stand as follows:

PUPILLA MUSCORUM var. CUPA (Jan).
Pupa alpicola Charp. [Vol. 26, p. 183].
Pupa halleriana Charp. [Vol. 26, p. 185].
Pupa madida Gredler [Vol. 26, p. 184].
Pupa muscorum var. *pratensis* Clessin [Vol. 26, p. 178].

PUPILLA STERRI (Voith). Vol. 26, p. 186.

According to Mermod (*l. c.*, p. 581) this differs from *P. cupa*, with which it was synonymized by O. Boettger, by the strong epidermal striae, often anastomosing, the excentric aperture with a strong cervical crest, and the more widely open umbilicus. See also, Manual, vol. 27, pp. 253, 254.

PUPILLA PSEUDOCYLINDRICA (Ping & Yen). Plate 24, fig. 10.

"Shell small, cylindrical in outline, shallowly umbilicated. Apex rounded, fairly broad. Whorls 6½. First whorl widening not so much as the second, which almost equals any of the following whorls in width. Then third, fourth, fifth, even sixth, which constitutes the body-whorl, all equal to one another in width, thus making the shell cylindrical. Apex and first whorl smooth, and surface of each of the following whorls marked with very fine oblique striae. Surface of each whorl moderately convex. Suture between each two whorls fairly deep. Aperture ovoid. Outer and inner lips continuous and somewhat expanded, with a thin callus on the parietal surface, which bears a very small, inconspicuous tooth. Umbilicus shallow and slit-like. Along the outer lip the peristomal region thickened, forming a blunt keel. The general color is yellowish white, and the apical region and the lips are purely white" (*Ping* and *Yen*).

Alt. 4 mm., diam. 1.7 mm., length aperture 1 mm., width 0.9 mm.

N. W. China: Aksu, in a dry river bed. Type 547 Fan Mem. Inst. Biol.

Truncatellina paseudocylindrica PING and YEN, Bull. Fan Memorial Institute of Biology, vol. 4, p. 278; *Truncatellina pseudocylindrica* on p. 279, fig. 15.

"This species resembles in some way *Truncatellina cylindrica* (Fér. 1821), but that its size is much larger, with one more whorl, the striae on its whorl surfaces are much finer, and its parietal surface has a small nodule or tooth, although it is very inconspicuous, make it different from the latter" (*Ping* and *Yen*).

This species and *Pupilla cupa* Jan, described by Ping and Yen from the same place (l. c., p. 279), require comparison with *Pupilla muscorum asiatica and P. cupa turcmenia.* I have not seen them, and it is a very difficult group.

PUPILLA (?) INERMIS Russell, 1931. Trans. Roy. Soc. Canada, (3), vol. 25, p. 15. Probably Paleocene. Alberta.

PUPILLA GRABAUI (Ping). *Pupa grabaui* Ping, 1929, Palaeontologia Sinica, Series B, VI, fasc. 5, p. 10, f. 3*a-c*, pl. 1, f. 3). Shueh Hua Shan, Hopei Province, China, in the supposed Hipparion red clay; if so, of Pliocene age. A sinistral species.

PUPILLA HOPEIENSIS (Ping). *Pupa hopeiensis* Ping, 1929, l. c., p. 11, f. 5*a-c*, pl. 1, f. 5*a-c*. Same locality and horizon.

MICROSTELE (Vol. 26, p. 147).

MICROSTELE PINGI, n. n. *Pupa subconica* Ping, 1929, l. c., p. 11, f. 4*a, b*; pl. 1, f. 4. Not *Pupa subconica* Sandberger, 1858. Shueh Hua Shan, Hopei Prov., China, in the supposed Hipparion red clay; if so, of early Pliocene (Pontian) age. I have not seen this fossil, but its characters seem to be wholly those of *Microstele.*

PUPOIDES Pfr. (Vol. 26, p. 108).

Pupoides "Fér." Hermannsen, 1848, Ind. Gen. Malac., vol. 2, p. 364, type *Helix carinula* Gmelin (Syst. Nat. (13), p. 3655, based upon Chemnitz, Conch. Cab. IX, p. 190, pl. 136, f.

1263, nos. 1-4). Being without generic definition this has only the status of a nude name, since the genotype is not a determinable species. The name therefore does not preoccupy *Pupoides* Pfr. 1854. "Pupoides" was not used in a generic or subgeneric sense by Férussac.

PUPOIDES HORDACEUS (Gabb). Vol. 26, p. 116.

Add to synonymy: *Pupoides eupleura* Chamberlin and Berry, 1931, Proc. Biol. Soc. Washington, vol. 44, p. 7, fig. 1 (Henry Mts., Utah, west of King's Ranch, type loc.; also Cannonville, Utah). Topotypes received from Prof. Chamberlin agree in every respect with *P. hordaceus*.

PAGODULINA Clessin (Vol. 27, p. 166).

Add to synonymy of the genus: *Pagodinella* Thiele, 1917, Nachrichtsblatt D. M. Ges., vol. 49, p. 24, new name for *Pagodula* Hesse. Type *Pupa pagodula* Desm.

LAURIA (Vol. 28, p. 86).

LAURIA BEQUAERTI, new species. Plate 24, figs. 12, 13, 14.

The shell is perforate and openly rimate; ovoid, tapering from the last whorl to the rounded, obtuse summit; chestnut colored. The surface is glossy, with fine, retractive striae of growth, more prominent below the suture. The whorls are moderately convex; suture impressed. The peristome is light brown, narrowly expanded, thickened within, the thickening excised in the upper third of the outer lip. Columellar margin dilated. The angular lamella tapers inward and is rather short, not penetrating deeply, outwardly curving towards and strongly connected with the insertion of the outer lip. Columella convex but without a superposed lamella or tooth.

Length 4.35 mm., diam. above aperture 2.2 mm.; 6½ whorls.

Length 3.65 mm., diam. above aperture 2.1 mm.; 5½ whorls. Cotype.

Length 3.65 mm., diam. above aperture 2.2 mm.; 5½ whorls. Cotype.

Belgian Congo: Lukafu River, Katanga, near the falls, in

moss dripping wet from spray of the falls, collected by Michael Bequaert. Cotypes 162443 A. N. S. P. and in Mus. Comp. Zool.

A young shell of fully four whorls has a long parietal lamella and four radial folds in the base (fig. 13). Three folds persist in a shell of fully 4½ whorls, but they are weaker.

It is more robust and darker colored than any of the South African Lauriae. *L. bruguierei* of Abyssinia is paler and more cylindric. *L. desiderata* (Preston), from Mt. Kenia at 9-10,000 ft., is apparently the species most nearly related, as it is the nearest geographically; from the description it is a smaller shell, said to measure 3 x 2 mm.

By its angular lamella entering only shortly, *L. bequaerti* differs from the majority of the typical section of *Lauria*. Like many of the Madeiran species, it lives in very wet places. A few of the shells are partially coated with hard calcareous material such as one sometimes sees deposited on fresh water shells.

LAURIA ZONIFERA n. n. (This vol. p. 86).

New name for *Pupa zonata* Bttg. 1883 (see vol. 27, p. 79), not *Pupa zonata* Gassies, 1869. Boettger proposed the name mut. *albina* for albinistic examples, but this name had been used in *Pupa* several times, as by Moquin-Tandon, 1855.

GEOGRAPHIC DISTRIBUTION OF THE PUPILLIDAE.

The family Pupillidae is essentially a group of the northern continents. The data now at hand indicate Eurasia as the main area of evolution and radiation. All of the major groups (subfamilies) occur in this continent. Of about 50 genera recognized in the family, 38, or about 75 percent, are represented in Eurasia, either living or as Tertiary fossils.

The southern continents and islands have, in addition to northern genera which extend into them, only about 8 endemic genera:

Gibbulina, South America.
Fauxulus, South Africa.
Campolaemus, St. Helena.
Costigo, Indo-Malayan and Melanesian islands.

Cylindrovertilla, Melanesia and tropical Australia.
Lyropupa, Hawaiian Islands.
Pronesopupa, Polynesia, Hawaii.
Pupoidopsis, Polynesia, Hawaii.

All of these are more or less closely related to genera occurring in Eurasia. There is no trace of Antarctic elements suggesting dispersal via Antarctica.

Of the 38 genera of Eurasia, 30 genera (18 of them Recent) occur in the western division of the Palaearctic Region, and about 15, all Recent, in the Oriental Region; 8 of these not in the Palaearctic. It is evident that old centers or areas of evolution are in both southeastern Asia and in the European subregion; but the presence of such Oriental genera as *Nesopupa, Sinalbinula* and *Microstele* in European Tertiary, and *Truncatellina* in Chinese Tertiary and in the Riukiu curve, is evidence that Tertiary exchanges of genera were more extensive than have taken place under the strongly differentiated climates of post-Tertiary time.

Few if any of the extinct Tertiary genera now known are generalized or synthetic types. The main evolution of the group seems to have been in the Paleocene and Cretaceous, and still remains to be recovered. The European Oligocene and Miocene pupillid fauna appears to be about as specialized and mature as the Recent, and contains many genera and subgenera still widely spread.

In no other family of land snails are the genera so widely distributed as are some of the genera of Pupillidae, such as *Gastrocopta, Pupilla, Pupoides* and *Nesopupa*. The data may be found in the lists on following pages, but the ranges and probable lines of dispersal of several genera are illustrated in figures 5 to 8, pages 142 and 143. These nearly world-wide ranges are an evidence of the antiquity and the great conservatism of the groups. Many of the genera of this family, as of most others, are restricted to single zoological regions or to smaller faunal divisions.

Figures 5 and 7 represent the distribution and probable routes of dispersal of two genera of northern origin, the dotted

areas on the map being more or less dubious. *Pupilla* proper has not spread far to the south, but the earlier subgenus *Gibbulinopsis*[1] has reached South Africa, Australia and Tasmania. The subgenus *Striopupilla* in western North America must be due to a much earlier migration than that of *Pupilla* s. str.

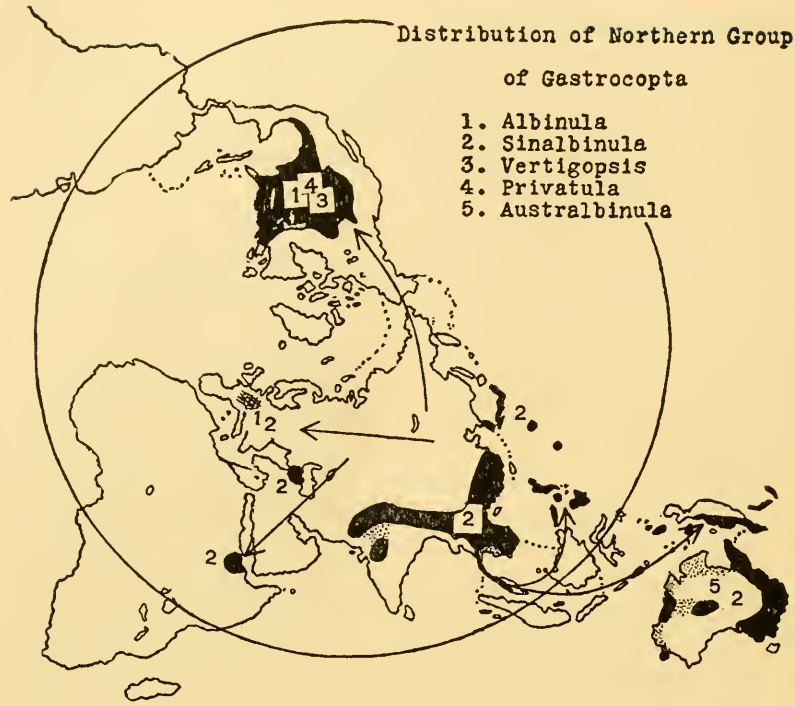
Fig. 5, the northern group of *Gastrocopta*, has about the same range as *Pupilla*, but it is still present in many islands between Asia and Australia, and it has been differentiated into several regional subgenera in its secondary areas, North America and Australia.

Fig. 8, the routes of dispersal of the typical group of *Gastrocopta* are problematic. The rather high stage of evolution shown by the complete concrescence of angular and parietal lamellae, and the great similarity of American and Ethiopian species are points in favor of recent evolution and dispersal of the stock; but on the other hand, its distribution in the tropics of both hemispheres, and the presence of strongly differentiated derivatives, such as *Immersidens, Chaenaxis* and probably *Gibbulina*, argue for considerable antiquity. It may be a genus which matured early in the Ethiopian Region and reached America via a transatlantic land bridge, but this would put it back into the Cretaceous or at least Paleocene, with practically no change in part of the stock since. Further paleontologic discoveries must be awaited before deciding between an Atlantic or the northern route; but in any case, the extreme similarity of African and American species is remarkable.

The very extensive distribution of some species of *Gastrocopta* due to commerce is not represented on the maps.

Fig. 6, *Pupoides* has much in common with *Gastrocopta* s. str. in distributional peculiarities, but unlike that group, *Pupoides* reached Australia. The problem of dispersal is the same in both genera. The presence of *Microstele* in European Miocene and apparently in Chinese Pliocene is interesting in this connection, as this genus appears to stand in an ancestral

[1] This is a prior name for *Primipupilla;* see vol. 27, p. 254.



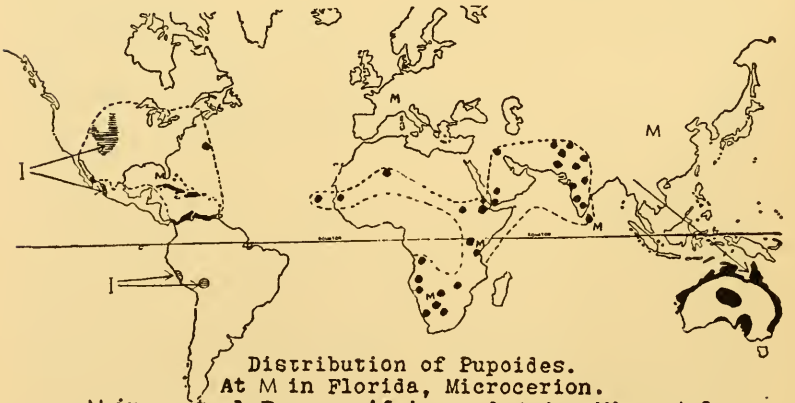
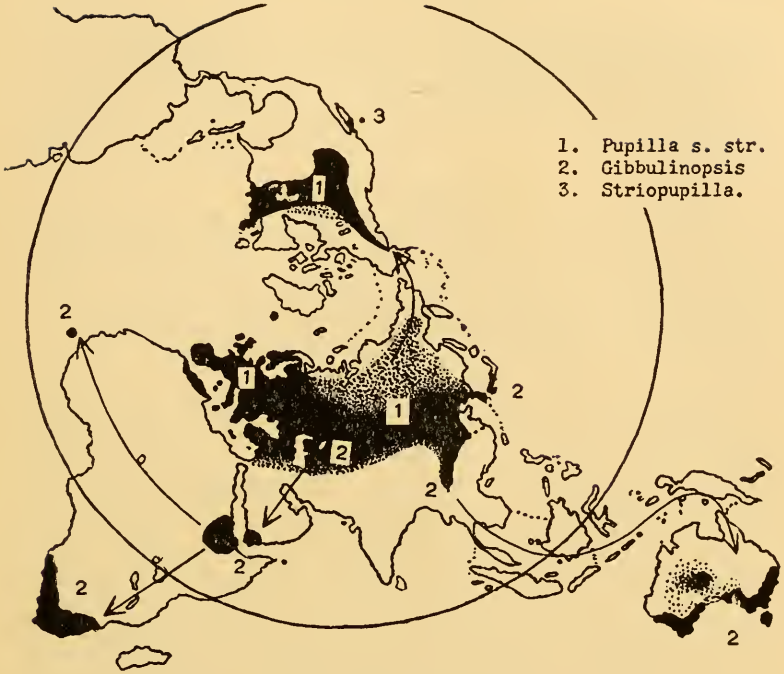
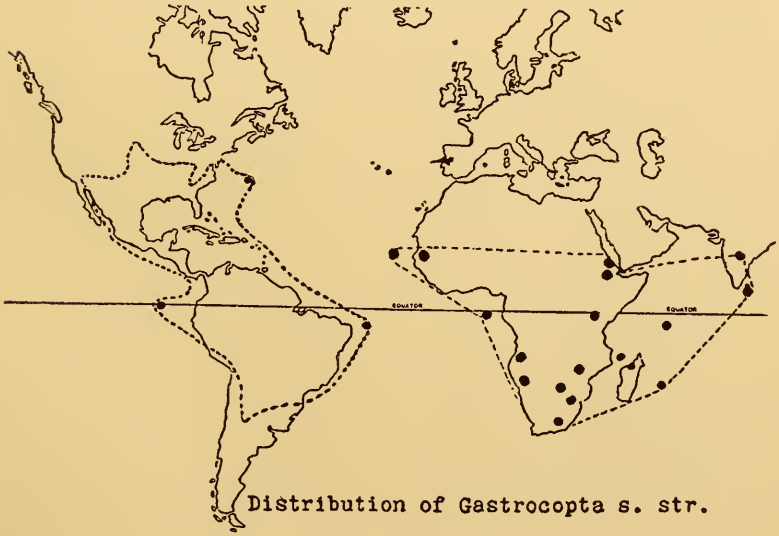

Distribution of Pupoides.
At M in Florida, Microcerion.
M in central Europe, Africa and Asia, Microstele.
At I the subgenus Ischnopupoides.

Fig. 5 (upper). Distribution of Northern Group of Gastrocopta.

Fig. 6 (lower). Distribution of Pupoides and its Allies.



Distribution of Pupilla.



Distribution of Gastrocopta s. str.

Fig. 7 (upper). Distribution of Pupilla.
Fig. 8 (lower). Distribution of Gastrocopta s. str.

relation to *Pupoides*. *Microcerion*, in the Upper Oligocene of Florida, is evidently a minor modification of *Microstele*. As living snails, *Microstele* has a few widely scattered species in Ceylon, East and South Africa, fragments of its once wide range.

Palaearctic Region.

Atlantic Islands.—In the archipelagoes of the north Atlantic the *Leiostyla* group of Lauriae has been widely deployed, with many endemic species forming several special subgenera and sections, and occupying stations from arid to subaquatic.

Madeiran species.

Besides a few obviously introduced species, *Lauria cylindracea* and *L. c. anconostoma* (27:51), Madeira has four genera of Pupillidae. *Staurodon* and several subgenera of *Lauria* are endemic. *Staurodon* stands close to *Nesopupa,* which was present in the European Oligocene and Miocene. The Lauriae are partly near European Oligocene and Miocene Leiostylas, and in part are intensely specialized derivatives from *Leiostyla*. The other genera are Palaearctic groups, here represented by endemic species. The fauna seems to have been derived from Europe not later than Miocene, and perhaps earlier.

Lauria cylindracea anconostoma Lwe. 27:51. Introduced.
L. fanalensis Lwe. 27:58.
(S.-g. *Scarabella*)
L. cassida Lwe. 27:88.
(S.-g. *Leiostyla*)
L. cheilogona Lwe. 27:90.
L. vincta Lwe. 27:91.
L. v. watsoniana P. 27:92.
L. irrigua Lwe. 27:92.
L. loweana Woll. 27:93.
L. l. transiens Woll. 27:96.
L. cassidula Lwe. 27:96.
L. concinna Lwe. 27:97.
L. laurinea Lwe. 27:98
L. sphinctostoma Lwe. 27:99.
L. s. arborea Lwe. 27:100.
L. s. heterodon P. 27:101.
L. s. simulator P. 27:101.
L. wollastoni Paiv. 27:102.
L. laevigata Lwe. 27:103.
L. recta Lwe. 27:104.
L. r. macilenta Lwe. 27:104.
(Sect. *Craticula*)
L. fusca Lwe. 27:105.
L. millegrana Lwe. 27:106.
L. abbreviata Lwe. 27:107.
L. corneocostata W. 27:108.
L. c. resticula W. 27:109.
L. relevata Woll. 27:110.
L. ferraria Lwe. 27:110.
L. degenerata Woll. 27:111.
L. monticola Lwe. 27:112.

L. m. pumilio W. 27:113.
L. calathiscus Lwe. 27:113.
(S.-g. *Wollastonula*)
L. gibba Lwe. 27:115.
(S.-g. *Mastula*)
L. lamellosa Lwe. 27:116.

Staurodon saxicola Lwe. 25:224.
S. s. seminulum Lwe. 25:225.

Truncatellina linearis Lwe. 26:62.

Columella microspora Lwe. 27:234.
C. limnaeana Lwe. 27:235.

Azores Archipelago.

As in Madeira, the *Leiostyla* stock is the most abundant group, and has been notably modified to form the subgenera *Senilauria* (28:88) and *Azoripupa* (27:127). *L. c. anconostoma* and *C. microspora* are apparently introduced forms.

Lauria cylindrica anconostoma Lwe. 27:51.
L. (Senilauria) fasciolata Morel. 27:123; 28:88.
L. (S.) f. hortana Pils. 27:123. Fayal.
L. (Leiostyla) fuscidula Morel. 27:124.
L. (L.) f. hexodon Pils. 27:125. San Miguel.
L. (L.) rugulosa Morel. 27:126. Pico.
L. (L.) vermiculosa Morel. 27:126. San Miguel.
L. (Azoripupa) tesselata Morel. 27:128. Santa Maria.

Columella microspora Lwe. 27:234.

Acanthinula azorica Pils. 27:193. San Miguel.

Canary Islands.

The occurrence of a large *Gastrocopta* on Tenerife is remarkable, but its affinities are unknown, and the record has not been confirmed by any later collector. *Lauria c. anconostoma* and *Columella microspora*, common to Madeira, the Azores and Canaries, are the only non-endemic species.

Gastrocopta moreletiana Grasset. 26: 228. Tenerife.
Granopupa granum bulimiformis Mss. 24:340.

Lauria c. anconostoma Lwe. 27:51. Introduced?
L. fanalensis pyramidata P. & S. 27:60. Tenerife.
L. (Leiostyla) castanea Sh. 27:118. Tenerife and Palma.
L. (L.) pythiella Mouss. 27:119. Tenerife, Palma, Hierro.
L. (L.) taeniata Sh. 27:120. Tenerife and Palma.

Truncatellina atomus Shuttl. 26:63. Tenerife.
Columella microspora Lwe. 27:234. Tenerife, Palma.
Acanthinula spinifera Mouss. 27:193. Palma, Grand Canary.

Cape Verde Islands.

While the Helices of these islands appear to be generically related to those of the Azores and Madeira, the few Pupillidae have a decidedly Ethiopian aspect. Three of the genera are Ethiopian, the other two, *Lauria* and *Truncatellina*, are Palaearctic genera which have spread widely, being common to Europe, the Atlantic islands and the Ethiopian Region, from Abyssinia to the Cape.

Gastrocopta acarus Bens. 24:122.
Pupilla fontana gorgonica Dhn. 26:206.

Lauria cylindracea anconostoma Lwe. 27:51.
dohrni Pfr. 27:53. S. Antao.

Pupoides gemmula Bens. 26:137.

Truncatellina molecula Dohrn. 26:63. S. Antao.

Pupillidae of European and Mediterranean subregions.

Four circumpolar genera, *Pupilla, Vertigo, Columella* and *Zoögenetes* extend to the Pacific the eastern limit of the Palaearctic Region, and into America. *Truncatellina* has species in China and the Riukiu Islands, and the single Recent species of *Ptychalaea* occurs in the Ogasawara (Bonin) group. Otherwise the European Pupillid fauna has nothing in common with the rest of the Palaearctic Region. The relation was more obvious in the middle Tertiary, when *Sinalbinula* and *Ptychalaea*, now living in China and the Japanese islands, were represented in the central European fauna.

Europe, North Africa and nearer Asia possess by far the richest fauna of Pupillidae in the world. There are 18 Recent and 12 additional Tertiary genera, of which no less than 11 Recent and 7 fossil genera are endemic. The largest Pupillidae, comprised in the subfamilies Orculinae and Abidinae (the Abida Group, vol. 24, p. xi), are, with the exception of the genus *Fauxulus*, all European.

Eastward, in central Asia, the Palaearctic Region has only a scanty fauna, listed on p. 148. In China and Japan there is a somewhat richer fauna, resembling the Miocene of Europe in the copious development of *Gastrocopta* and *Gibbulinopsis*.[1] *Vertigo* also is well represented.

In the following list of the genera of the European system, those restricted to that region are starred (*). References are added to volume and page where the genera and species are described. The geological age of first appearance is added.

Odontocyclas* 24:254.
Sandahlia* 24:258.
Abida* 24:262; 25:370; 27:212, 269; 28:122. Lower Eocene.
Granopupa* 24:332; 27:214.
Chondrina* 25:1; 27:212, 283; 28:122.
Pupilla 26:152; 27:253, 254; 28:135. Upper Oligocene.
Lauria 27:43, 258, 319. Upper Oligocene (Subg. *Leiostyla*).
Orcula* 27:1, 256; 28:88, 123. Paleocene.
Orculella* 28:92.
Pagodulina* 27:166, 320. Upper Pliocene.
Spelaeodiscus* 27:180.
Agardhia* 27:129, 319. Miocene.
Vertigo 25:69; 27:216; 28:93. Eocene.
Truncatellina 26:58; 27:229; 28:105. Upper Oligocene.
Columella 27:232; 28:109.
Spermodea* 27:186. Upper Oligocene, Lower Miocene.
Acanthinula 27:188. Paleocene.
Zoögenetes 27:195.

The following genera occur fossil in the European Tertiary but are now either extinct, or are no longer living in the European fauna. Genera starred (*) are extinct and endemic.

Gastrocopta. 24:112.
  Albinula. Middle Oligocene to Pliocene.
  Sinalbinula. Late Oligocene to Pliocene.
Microstele 26:147. Miocene.
Enneopupa* 27:222. Upper Oligocene.
Paracoryna* 27:132, 320. Miocene.

[1] It is rather a pity that the inappropriate name *Gibbulinopsis* has to be used in place of *Primipupilla*. See vol. 27, p. 254.

Ptychalaea. 25:220; 27:225. Miocene to Pliocene.
Paracraticula* 27:221. Eocene.
Glandicula* 25:221. Upper Oligocene to Miocene.
Pseudelix* 25:222. Upper Oligocene.
Nesopupa 25:274. Upper Oligocene to Miocene.
Acmopupa* 26:101. Upper Oligocene.
Negulus 26:101; 27:231. Upper Eocene to Pliocene.
Acanthopupa* 27:198. Upper Oligocene.

Central Asia, Transcaucasus and Turkestan to N. China.

Gastrocopta (Sinalbinula) theeli West. 24:118. Transcaucasus.

Pupilla muscorum asiatica Mlldff. 26:179. Turkestan, N. China.
P. m. lundströmi West. 26:179. Turkestan, northward.
P. triplicata inops Reinh. 26:180. Transcaucasus.
P. t. luxurians Reinh. 26:192. Transcaucasus.
P. cupa turkestanica West. 26:187. Turkestan.
P. c. turcmenia Bttg. 26:188, 238. N. W. China, etc.
P. (Gibbulinopsis) armeniaca Issel. 26:193. Armenia.
P. (G.) signata Mouss. 26:194. Turkestan, etc.
diecki Gredl. 26:196.
P. (G.) interrupta Reinh. 26:196. Transcaucasus.
P. (G.) eurina Bens. 26:203. Nepal, Kashmir.
P. (G.) annandalei Pils. 26:202. Upper Burma.
P. (G.) chinensis Hilb. 26:198. Kansu, China.
P. (G.) richthofeni Hilb. 26:198. Kansu.
P. (G.) aeoli Hilb. 26:199. Kansu.
P. (G.) heudeana grandis Mlldff. 26:201. Kansu.
P. pseudocylindrica P. & Y. 28:136. Aksu, N. China.

Orcula doliolum tereticollis West. 27:23; 28:133. N. Persia.

Vertigo thibetica Bens. 24:138; 25:378. Thibet.
V. teilhardi P. & Y. 28:101. Aksu, N. China.
V. regularis West. 25:188. Turkestan.

Maritime Provinces of Siberia.

Vertigo denudata Mouss. 25:156. Vladivostok.
V. modesta Say. 25:123. Kamchatka.
V. krauseana Reinh. 25:136. E. Siberia.
V. alpestris Alder. 25:197. Vladivostok.

Zoögenetes harpa Say. 27:196. Kamchatka.

Japan, Korea and China.

North China Pupillids are enumerated above. The fauna of south China is included here for convenience; hence such Oriental Region genera as *Hypselostoma* and *Anauchen*. *Boysidia* and *Pupisoma* enter the lower border of the Palaearctic Region. The Gastrocopts belong to subgenus *Sinalbinula*. *Microstele* (28:137) appears to be represented in the Chinese Pliocene, but is now confined to the Oriental and Ethiopian Regions. *Truncatellina*, living in the Riukiu Islands, is only known as a fossil on the Chinese mainland (28:108). *Vertigo* seems to be rare except in northern Japan. *Ptychalaea*, a genus of the European Miocene, is represented by a single living species on the Bonin Islands.

No Pupillidae are yet known from Formosa or Hainan.

Gastrocopta chichijimana Pils. 24:105. Ogasawara.
G. c. ogasawarana Pils. 24:106. Ogasawara (Bonin) Is.
G. boninensis Pils. 24:107. Ogasawara (Bonin) Is.
G. armigerella Reinh. 24:107. Japan, China.
G. a. hachijoensis Pils. 24:109. Hachijo-jima.
G. coreana Pils. 24:110. Korea.
G. hirasei Pils. 24:110. China.
G. monadicula Heude. 24:111. China.
G. meridionalis Mlldff. 24:111. China.

Hypselostoma insularum Pils. 24:182: 27:211. Riukiu Is.

Anauchen angulinus Gredl. 24:191. China.

Boysidia hunana Gredl. 24:194. Yangtse Valley.
B. h. conspicua Mlldff. 24:195. Near Canton.
B. dorsata Anc. 24:195. Lake Poyang.
B. hangchowensis Pils. & Hir. 24:196. Prov. Chekiang.
B. strophostoma Mlldff. 24:197. Guang-dung Province.
B. plicidens Bens. 24:198. China, Japan.
B. hupeana Gredl. 24:206. Prov. Hupeh.

Vertigo eogea Pils. 25:151. Hokkaido.
V. hydrophila Reinh. 25:152. Hakodate.
V. hachijoensis Pils. 25:153. Hachijo-jima.
V. kushiroensis Pils. 25:153. Hokkaido.
V. hirasei Pils. 25:154. Kiushiu.
V. japonica Pils. & Hir. 25:155. Okinoerabushima.
V. j. coreana Pils. 25:156. Korea.
V. j. tosana Pils. 25:156. Tosa, Shikoku.

Ptychalaea dedecora Pils. 25:158, 273. Ogasawara-jima.
Truncatellina insulivaga Pils. 26:84. Riukiu Is.
Columella edentula Drap. 27:242. Saghalien I.

Pupisoma japonica Pils. 26:25. Hirado, Hizen.
P. harpula Reinh. 27:198. Tokyo.

Ethiopian Region.

The relations of this Pupillid fauna are mainly with the Palaearctic Region, but also with the Oriental, and by the presence of *Gastrocopta* s. str., *Pupoides* and *Microstele*, with the middle American. The only strongly characterized endemic group is *Fauxulus*, which by conchological features appears to belong to the Abidinae; but it is evidently an old group in South Africa. *Afripupilla* (*Pupilla tetrodus*) is another endemic form, but of uncertain affinities. *Gastrocopta* is represented in Abyssinia by one or two species of *Sinalbinula* (a Palaearctic group), but the tropical and South African species belong to the typical group of *Gastrocopta*, and are closely related to those of South America and the West Indies, the Mascarene Islands and India. The following genera appear to be of Palaearctic origin:

Fauxulus	Negulus
Orcula	Truncatellina
Pupilla	Columella
Lauria	Acanthinula

Elements common to the Oriental Region are:

Gastrocopta s. str.	Pupisoma
Pupoides	Nesopupa
Microstele	

Two of these, Microstele and Nesopupa, are represented also in European Miocene.

Gastrocopta pleimesi Jick. 24:119. Abyssinia.
G. haggenmacheri Jick. 24:358. Abyssinia.
G. klunzingeri Jick. 24:120. Abyssinia.
insulsa Prest. 24:359.
G. k. senegalensis Malz. 24:121. Senegal.
G. hermosa Jouss. 24:121. Eritrea.
G. thomasseti Pils. 28:71. Natal.

G. damarica Anc. 24:125, 359. S. and S.-W. Africa.
microbus Dtz. 24:123; 27:209. Senegal.
G. annobonensis Gir. 24:124, 27:208. Anno-Bom.
G. flocculus Mor. 24:124. Angola.
G. duplicata Prest. 24:127. Tanganyika Territory.

Fauxulus capensis Küst. 24:236. Cape Province.
F. burnupianus Pils. 28:73. Cape Province.
F. pamphorodon Bs. 24:240. Cape Province.
(S.-g. *Tomigerella*)
F. crawfordianus M. & P. 24:242. Cape Province.
F. layardi Bs. 24:243. Cape Province.
F. l. stoaphora Bs. 24:245. Cape Province.
F. fryanus Bs. 24:246, 28:121. Cape Province.
(S.-g. *Anisoloma*)
F. pereximius M. & P. 24:247. Cape Province.
F. falconianus Pils. 28:75. Natal.
F. barnardi Conn. 28:121. Cape Province.
F. mcbeanianus M. & P. 24:249. Natal.
F. glanvillianus Anc. 24:249. Cape Province.
F. g. novenarius Pils. 24:250. Cape Province.
F. g. darglensis Bp. 24:250. Natal.
F. g. tomlini Bp. 24:252. Cape Province.
F. ponsonbyanus Mor. 24:253. Cape Province and Natal.

Pupilla antinorii Pal. 26:193. Aden.
P. fontana Kr. 26:207; 27:255. S. and S. W. Africa.
P. (Afripupilla) tetrodus Bttg. 26:216. S. Africa.

Lauria bruguierei Jick. 27:61. Abyssinia.
L. wouramboulchiensis Conn. 28:86. Abyssinia.
L. desiderata Prest. 27:62. Mt. Kenia, Tanganyika Terr.
L. bequaerti Pils. 28:138. Katanga, Belgian Congo.
L. farquhari M. & P. 27:63. Cape Province.
L. dadion Bs. 27:64, 259. Cape Prov., Natal.
L. cryptoplax M. & P. 27:65. Cape Province.
L. tabularis M. & P. 27:65. Cape Province.

Pupoides coenopictus Hutt. 26:123. S. Africa.
P. senegalensis Morel. 26:136. Gorée I., Senegal; Angola.
P. senaariensis Pfr. 26:136. Eritrea to Senaar; Egypt.
P. cerealis Palad. 26:132. Aden.
hoggarensis Pall. 28:81. Hoggar.
P. reboudi Bgt. 26:132. Prov. Constantine, Algeria.
P. aethiopicus Bgt. 26:132. Hamacen Plateau.
P. fabianus Gredl. 26:133. Soudan.

P. bawriensis Tayl. 26:134. Zanzibar channel.
P. zanguebaricus Tayl. 26:134, 27:251. Zanzibar.
P. chanlerensis Prest. 26:135. Tanganyika Territory.
P. gaziensis Prest. 26:135. Tanganyika Territory.
P. consanguineus Prest. 26:135. Tanganyika Territory.
P. calaharicus Bttg. 26:138. Rhodesia, south and west.
P. minusculus Mor. 26:139, 27:252. S. W. Africa.
P. bryantwalkeri Pils. 27:251. Cape Province.
P. samavaensis Pal. 26:128. Aden.
P. maharasicus Bgt. 26:128. Arabia.
P. vermiformis Pal. 26:129. Aden.
P. marebiensis Bgt. 26:129. Arabia.
P. kursiensis Bgt. 26:130. Aden.
P. ragius Jouss. 26:130. Aden; Abyssinia.

Microstele noltei Bttg. 26:150. Bechuanaland; Kalahari.
oblonga Bttg. 26:150. Damaraland.
M. iredalei Prest. 26:148. Tanganyika Territory.

Orcula imbricata Jick. 27:25. Abyssinia, Eritrea.

Nesopupa bisulcata Jick. 25:339. Abyssinia.
N. b. rhodesiana Pils. 25:360. Victoria Falls.
N. griqualandica M. & P. 25:357. S. Africa.
N. farquhari Pils. 25:358. Cape Province.
N. iota Prest. 25:361. Tanganyika Territory.
N. corrugata Prest. 25:361, 28:110. Victoria Falls.
N. vengoensis Conn. 28:111. Portuguese E. Afr.
N. bandulana Conn. 27:226. Portuguese E. Afr.
N. megalomastoma Malz. 25:362. W. Africa.

Costigo (?) nobrei Gir. 25:368. San Thomé.

Truncatellina lardea Jick. 26:86. Abyssinia.
T. schilleri Jick. 26:87. Abyssinia.
T. similis Jick. 26:88. Abyssinia.
T. blanfordi Jick. 26:89. Abyssinia.
T. naivashensis Prest. 26:89. Tanganyika Territory.
T. mutandaensis Prest. 26:90. Tanganyika Territory.
T. perplexa Bp. 26:91. South Africa.
T. pretoriensis M. & P. 26:92. S. Africa.
T. dysorata M. & P. 26:94. S. Africa.
T. quantula M. & P. 26:95. S. Africa.
T. iota M. & P. 26:95. S. Africa.
T. i. livingstonae Bp. 26:97. S. Africa.
T. sykesi M. & P. 26:97. S. Africa.
T. s. inconspicua Bp. 26:98. S. Africa.

Negulus reinhardti Jick. 26:102. Abyssinia.
N. abyssinicus Jick. 26:103. Abyssinia.
N. kenianus Prest. 26:103. Mt. Kenia.

Columella pygmaeorum Pils. & Ckll. 28:109. Tshibinda, Belg. Congo.

Pupisoma orcula Bs. 26:31. S. Africa.
steudneri Jick. 26:35. Abyssinia.
P. japonica Pils. 26:25. S. Africa.

Acanthinula peracanthoda Bgt. 27:194. Abyssinia.
A. expatriata Prest. 27:194. Mt. Kenia.

Saint Helena.

This island has an African fauna of evidently ancient date.

Lauria cylindracea anconostoma Lwe. 27:51. Introduced.
Negulus obliquecostatus Sm. 26:104.
Nesopupa (Helenopupa) turtoni Sm. 25:363.
Campolaemus perexilis Sm. 25:365.

Mascarene Islands, Madagascar, Comoros.

The Gastrocopts and Nesopupae are related to those of both the Ethiopian and Oriental Regions. *Pupilla* and *Lauria* to the Ethiopian forms.

Gastrocopta seignaciana C. & F. 24:128, 27:208. Comoro Is.
G. tripunctum Mor. 24:130. Comoro Is.
G. microscopica Mts. 24:131. Seychelles.
G. lienardiana Cr. 24:132. Rodriguez.
G. l. eudeli Pils. 24:133. Reunion.
G. madagascariensis B. & S. 24:210. Madagascar.

Pupilla pupula Desh. 26:214, 28:86. Reunion.

Lauria bourbonensis Pils. 27:62. Reunion.

Nesopupa gonioplax Pils. 25:351. Mauritius.
N. micra Pils. 25:351. Mauritius.
N. minutalis Mor. 25:352, 27:228. Comoro Is.
N. rodriguezensis Conn. 28:110. Rodriguez.
N. comorensis Pils. 25:353. Comoro Is.
N. incerta Nev. 25:353. Reunion.
N. ventricosa Ad. 25:354. Mauritius.
N. praslinensis Nev. 25:355. Seychelles.

Costigo (?) borbonica H. Ad. 25:367. Reunion.
C. (?) desmazuresi Cr. 25:368. Rodriguez.

Oriental Region—India and Ceylon.

Related to the Ethiopian Region by *Gastrocopta s. str., Pupoides, Microstele* and *Nesopupa,* and to the Indo-Chinese fauna by the presence of *Sinalbinula* and *Boysidia. Truncatellina* and *Columella* are Palaearctic elements barely entering the Oriental borders, but included here for convenience.

Gastrocopta mimula Bens. 24:134. Ceylon.
G. serrula Bens. 24:135. India.
G. (Sinalbinula) bathyodon Bens. 24:136. India.
G. (S.) huttoniana Pfr. 24:137. India.

Boysidia plicidens Bens. 24:198. India etc.
B. landurensis Pils. 24:204. India.

Pupilla (?) eurina Bens. 26:203. Nepal, Kashmir.
P. (?) seriola Bens. 26:204. Cuttack, Darjiling etc.
P. (?) diopsis Bens. 26:205. Nerbudda Valley.

Pupoides coenopictus Hutt. 26:123. India.
P. lardea Pfr. 26:126, 237. India.
P. karachiensis Peile. 28:80. India.
P. doriae Issel. 26:122. Persia.
P. tutulus Rve. 26:122. India.

Microstele muscerda Bens. 26:148. Ceylon, India?

Nesopupa barrackporensis Gude. 25:348. India.
N. brevicostis Bens. 25:346. Bengal.
N. salemensis Blf. 25:347. Kalryen Hills.
N. cinghalensis Gude. 25:347. Ceylon.

Pupisoma evezardi Blf. 26:24, 235. Bor Ghat.
P. miccyla Bens. 26:26. Ceylon.
P. longstaffi G.-A. 26:27. Ceylon.
P. cachariсum G.-A. 26:29. Silchar.
P. orcula Bens. 26:31. India.

Boysia boysii Pfr. 26:226. India.

Truncatellina himalayana Bens. 26:71. Simla etc.

Columella gutta Bens. 27:241. Spiti Valley.

Burma, Indo-China, Malay Peninsula.

The Gastrocoptas belong to the subgenus *Sinalbinula.* The extraordinary development of endemic genera of several col-

lateral lines of Gastrocoptinae characterizes this and the adjacent insular subregion. *Pupisoma* is abundant, but except for *Nesopupa*, the Ethiopian genera are lacking.

Gastrocopta ejecta Bav. & Dautz. 24:111. Bay of Along.
G. avanica Bens. 24:138. Burma.
G. palmira Stol. 24:139. Penang.

Hypselostoma tubiferum Bens. 24:178. Burma.
H. annamiticum Mlldff. 24:178. Annam.
H. a. altius Pils. 24:181.
H. laidlawi Cllge. 24:181. Malay Peninsula.

Anauchen messageri Bav. & Dautz. 24:189. Tonkin.
A. gereti Bav. & Dautz. 24:189. Tonkin.
A. rochebruni Mab. 24:190. Tonkin.

Boysidia robusta Bav. & Dautz. 24:201. French Indo-China.
B. lamothei Bav. & Dautz. 24:202. French Indo-China.
B. paviei Bav. & Dautz. 24:203. French Indo-China.
B. dayana Stol. 24:205. Burma.
B. salwiniana Theob. 24:206. Burma.
B. kelantanensis Sykes. 24:208. Malay Peninsula.

Gyliotrachela [1] bensoniana Blf. 24:211. Ava.
G. hungerfordiana Mlldff. 24:212. Perak.
G. transitans Mlldff. 24:214. Samui Is.
G. striolata Mlldff. 24:215. Samui Is.
G. crossei Morl. 24:215. Tonkin.
G. c. endodonta Mlldff. 24:217. Tonkin.
G. c. brevituba Mlldff. 24:217.

Systenostoma pulverea Bav. & Dautz. 24:225. Tonkin.
S. pauperrima Bav. & Dautz. 24:225. Tonkin.
S. defixa Bav. & Dautz. 24:226. Tonkin.

Pupilla annandalei Pils. 26:202. Burma?

Nesopupa filosa Theob. & Stol. 25:345. Burma.

Pupisoma lignicola Stol. 26:23. Burma.
P. l. unidentata G.-A. 26:24, 235.
P. constrictum G.-A. 26:28. Andaman Is.
P. orcella Stol. 26:29. Penang.
P. orcula Bens. 26:33. Generally distributed.

[1] Mr. Tomlin evidently meant to write "*Gyliotrachea*". By a pen or typographic error the name was so spelled in this volume, p. 73.

Indo-Malayan Islands, Philippines, Java, Borneo, etc.

These islands are faunally similar to the foregoing mainland area. *Aulacospira* and the gastrocopt subgenus *Cavipupa* are endemic.

Gastrocopta servilis Gld. Introduced in Philippines.
lyonsiana Anc. 24:141.
G. (Sinalbinula) capillacea Dhn. 24:144. Philippines.
G. (S.) pediculus Shuttl. 24:145.
G. (S.) p. ovatula Mlldff. 24:149. Philippines.
G. (S.) niobe Fult. (*moellendorffiana* Pils.). 28:119. Philippines.
G. (Cavipupa) euryomphala Pils. 28:120. Philippines.

Boysidia boettgeri Mlldff. 24:208. Java.

Hypselostoma luzonicum Mlldff. 24:183. Philippines.
H. l. major Mlldff. 24:360. Philippines.
H. l. imbricata Mlldff. 24:360. Philippines.
H. sibuyanicum Mlldff. 24:184. Philippines.
H. polyodon Mlldff. 24:185. Philippines.
H. quadrasi Mlldff. 24:185, 360. Philippines.
H. pusillum Mlldff. 24:186. Philippines.
H. roebelini Mlldff. 24:186. Philippines.
H. edentulum Mlldff. 24:187. Philippines.

Gyliotrachela fruhstorferi Mlldff. 24:207. Java.
G. everetti Smith. 24:218. Kalao I.

Aulacospira mucronata Mlldff. 24:222. Cebu.
A. hololoma Mlldff. 24:222. Cebu.
A. porrecta Hid. 24:222. Ilin.
A. triptycha Q. & M. 24:223. Masbate.
A. scalatella Mlldff. 24:223. Luzon.
A. rhombostoma Mlldff. 24:223. Tablas.
A. (Pseudostreptaxis) azpeitiae Hid. 24:224. Busuanga.

Nesopupa moreleti Brn. 25:339. Borneo.
N. moellendorffi Bttg. 25:341. Philippines.
N. nannodes Mlldff. 25:341. Philippines.
N. malayana Iss. 25:342. Philippines, Borneo.

N. proscripta Sm. 25:344. Christmas I.

Costigo calamianica Mlldff. 25:367. Philippines.

Pupisoma orcula Bens. 26:31. Java.
P. pulvisculum Iss. 26:30. Borneo.
"Acanthinula" perpusilla Mlldff. 27:195. Java.
"A" tiluana Mlldff. 27:195. Java.

Austro-Malayan and Melanesian Islands.

Gastrocopta (Sinalbinula) pediculus Sh. 24:145.
G. (S.) dahli Thiele. 28:72. Bismarck Archipelago.
G. (S.) semiclausa Thiele. 28:73. Bismarck Archipelago.
G. (S?) microsoma T.-C. 24:152, 27:209. Aru Is.
G. (S.) recondita T.-C. 24:153, 27:209. Aru Is.
G. (S?) neocaledonica Pils. 24:154. New Caledonia.
G. (S.) macdonnelli macrodon Pils. 24:164. New Guinea.
G. (S.) niobe Fult. 24:153, 28:119. Tenimber Is.
moellendorffiana Pils. 24:145. Bohol, Philippines.

Gyliotrachela dohertyi Fult. 24:219. Tenimber Is.

Nesopupa novopommerana Rensch. 28:112. Bismarck Archip.
N. quadrasi transaequatorialis Rch. 28:113. Bismarck Archip.
N. moluccana Bttg. 25:338. Moluccas.
N. selebensis T.-C. 25:343. Celebes.
N. norfolkensis Sykes. 25:333; 27:227. Norfolk I.
N. lifouana Gass. 25:333. Lifu, Loyalty Is.
N. mariei Crosse. 25:334. New Caledonia.

Costigo saparuana Bttg. 25:366. Moluccas.

Cylindrovertilla fabreana Crse. 26:47. New Caledonia.
C. paitensis Crse. 26:48. New Caledonia.

Pupisoma vimontiana Crse. 26:35. New Caledonia.
(= P. orcula Bs. ?).

Pupillidae of Australia and Tasmania.

Australia is not rich in Pupillidae. Of the six genera represented, *Pupisoma* is apparently a recent importation on plants. *Cylindrovertilla*, elsewhere found only in New Caledonia, and *Gyliotrachela*, a genus of the Malay Peninsula and East Indies to the Tenimber islands, are confined to tropical Queensland. *Gastrocopta*, *Pupilla* and *Pupoides* are widely distributed.

Gastrocopta is represented by species of the subgenus *Sinalbinula*, a Palaearctic group which extends from Japan and China through the tropics to Australia, and by *Australbinula*, special to Australia, but evidently a derivative of *Sinalbinula*.

A key to the species of *Gastrocopta* may be found in vol. 24, p. 155.

Pupoides appears in several species not differing materially from the typical forms of the northern continents. *Glyptopupoides*, referred to *Pupoides* as a subgenus, is endemic in Australia.

Pupilla is represented by species of *Gibbulinopsis*, also traceable to the Palaearctic Region, but like *Pupoides* it is here very widely separated from its present-day range in the other continents, as neither genus has occurred in the East Indies. These genera are doubtless emigrants from Asia which reached Australia by a chain of early Tertiary connections through the East Indies, where they appear to have become extinct.

"*Pupa*" *scotti* Braz. of Fitzroy Island, is not sufficiently known for generic reference.

Gastrocopta pediculus Sh. 24:158. Eastern Australia.
rossiteri Braz. 24:159. New South Wales.
bannertonensis Gabriel. 28:118. Victoria.
G. p. queenslandica Pils. 24:159. Queensland.
G. strangei Pfr. 24:157. N. S. Wales.
G. mooreana Smith. 24:160, 26:230. W. Australia.
G. macdonnelli Braz. 24:162. N. E. Australia.
G. tatei Pils. 24:165. Central Australia.
G. (Australbinula) hedleyi Pils. 24:166. Queensland.
G. (A.) mussoni Pils. 24:167. Queensland.
G. (A.) laripinta Tate. 24:168. Central Australia.
G. l. deserti Pils. 24:170. Central Australia.
G. (A.) wallabyensis Sm. 24:171. W. Australia.

Gyliotrachela australis Ohdner. 26:232. Queensland.

Pupilla australis Angas. 26:218. Australia, Tasmania.
P. ficulnea Tate. 26:221. Central Australia.

Pupoides adelaidae A. & A. 26:140. N. S. W.; S. Australia.
P. pacificus Pfr. 26:141.
f. sinistralis Pils. 26:144.
P. contrarius Smith. 26:144. W. Australia.
P. c. eremicola Tate. 26:145. Central Australia.
P. beltianus Tate. 26:145. Central Australia.
P. myoporinae Tate. 26:146. S. Australia.

P. ischnus Tate. 26:146. Central Australia.
P. (Glyptopupoides) hedleyi Pils. 27:252. Queensland.

Cylindrovertilla kingi Cox. 26:44. Queensland.
C. hedleyi Pils. 26:46. Queensland.
C. fabreana Crosse. 26:47. Queensland.

Pupisoma orcula Bens. 26:31, 34. Queensland.
circumlitum Hedley.

"Pupa" scotti Braz. 26:222. Fitzroy I.

Polynesia and Micronesia.

The Gastrocoptas of this region are apparently all due to importation within the period of human occupation. Probably Pupoidopsis, which lives near the sea at low elevations, was also carried about by the Polynesians. The Nesopupae are endemic.

Gastrocopta servilis Gld. Introduced.
lyonsiana Anc. 24:141.
G. (Sinalbinula) pediculus Shuttl. 24:145.

Nesopupa tantilla Gld. 25:324. Society Is.
N. pleurophora Shuttl. 25:326. Tahiti, Marquesas?
N. armata Pse. 25:327, 28:112. Society Is.; Rarotonga.
N. paivae Crse. 25:328. Gambier Is.; Taumotus.
N. dentifera Pse. 25:329. Aitutaki, Cook Group.
N. godeffroyi Bttg. 25:330. Samoa.
N. tongana Bttg. 25:331. Tonga Is.
N. vitiana Bttg. 25:332. Fiji Is.
N. quadrasi Mlldff. 25:335. Guam.
N. eapensis Bttg. 25: 335. Yap, Carolines.
N. ponapica Mlldff. 25:336. Ponape.

Pronesopupa senex Iredale. 26:1. Kermadec Is.
P. simplaria Pse. 26:2. Marquesas.

Pupoidopsis hawaiensis P. & C. 26:107. Tuamotus; Christmas I.

Hawaiian Islands.

As in Polynesia, the species of *Gastrocopta* are doubtless due to importation, first (*G. pediculus*) by the Polynesians, who probably brought *Pupisoma* also, and later by the Europeans (*G. servilis*). The genus *Lyropupa* and several subgenera of *Nesopupa* and *Pronesopupa* are endemic. All of

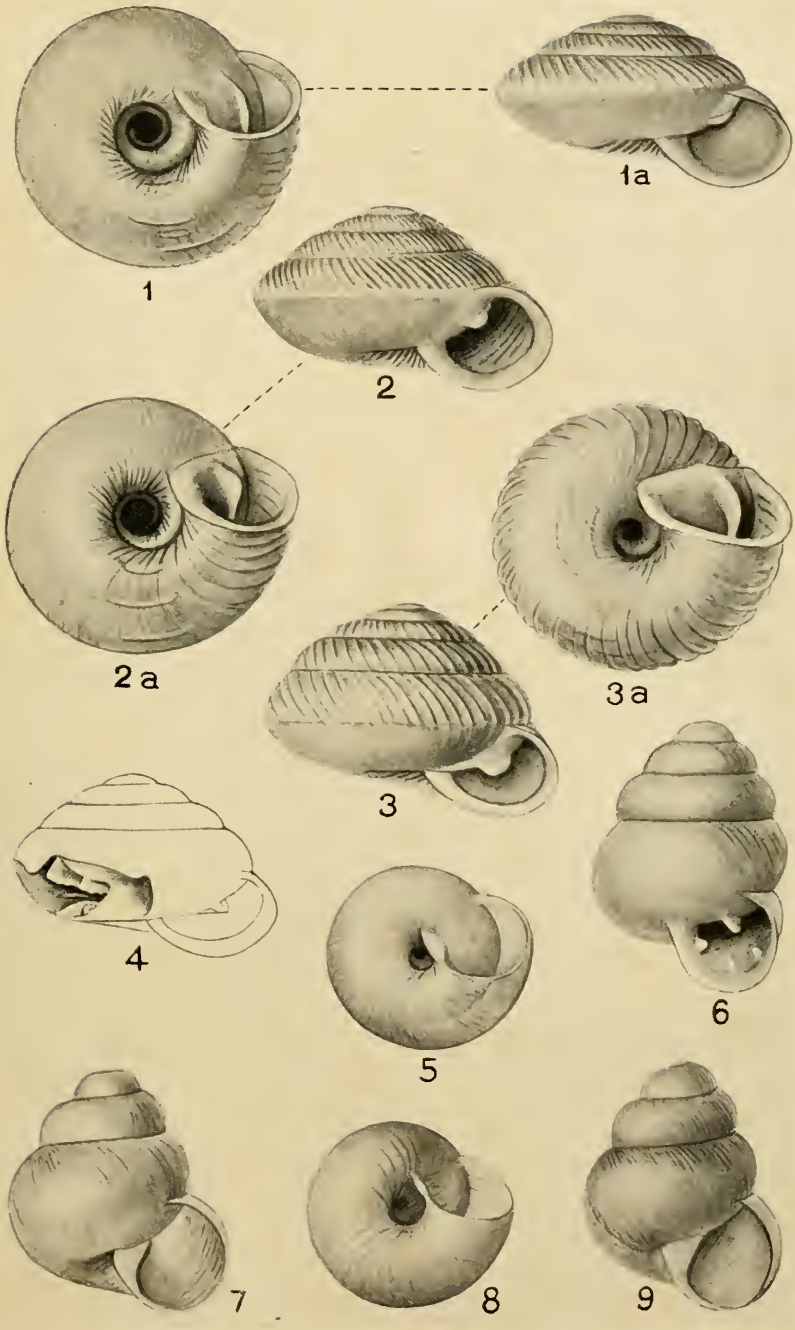
the species of these groups are special to these islands. It is not likely that the Hawaiian Pronesopupae are directly related to the type of that genus; they are more likely to be a parallel evolution from *Nesopupa*. For subgeneric classification of Nesopupa and Pronesopupa see 25:275.

Species referred to *Columella* should be dissected, as that reference appears improbable, though the shells are certainly very similar.

Gastrocopta servilis Gld. Introduced.
lyonsiana Anc. 24:141. Oahu.
G. (Sinalbinula) pediculus nacca Gld. 24:149. Introduced.

Pupoidopsis hawaiensis Pils. & Cooke. 26:107. Kauai; Oahu; Molokai; W. Maui.

Lyropupa lyrata Gld. 25:233. Oahu.
L. l. uncifera P. & C. 25:236. Oahu.
L. l. fossilis C. & P. 25:237. Oahu.
L. microthauma Anc. 25:238. Oahu.
L. rhabdota C. & P. 25:239. Molokai.
L. r. pleuris P. & C. 25:240. Molokai.
L. r. lanaiensis Cooke. 25:241. Lanai.
L. r. baldwiniana Cooke. 25:241. W. Maui.
L. thaanumi C. & P. 25:242. E. Maui.
L. prisca Anc. 25:243. Hawaii.
L. striatula Pse. 25:246, 27:223. Hawaii.
L. clathratula Anc. 25:245. Hawaii.
L. truncata Cooke. 25:247. Hawaii.
L. spaldingi P. & C. 25:248. Oahu.
L. mirabilis Anc. 25:249. Oahu.
L. antiqua C. & P. 25:250. Oahu.
L. hawaiiensis Anc. 25:251. Hawaii.
L. sparna C. & P. 25:252. Molokai.
L. s. sinulifera P. & C. 25:253. Molokai.
L. anceyana C. & P. 25:253. Hawaii.
L. scabra P. & C. 25:253. Maui.
L. costata Pease. 25:272; 27:223. Hawaii, Kahoolawe.
kahoolawensis P. &. C. 25:256.
L. c. puukolekolensis P. & C. 25:258. Molokai.
L. perlonga Pse. 25:258. Oahu.
L. p. cylindrata P. & C. 25:261. Oahu.
L. p. interrupta P. & C. 25:261. Oahu.
L. p. filocostata C. & P. 25:262. Kauai.
L. micra C. & P. 25:263. Oahu.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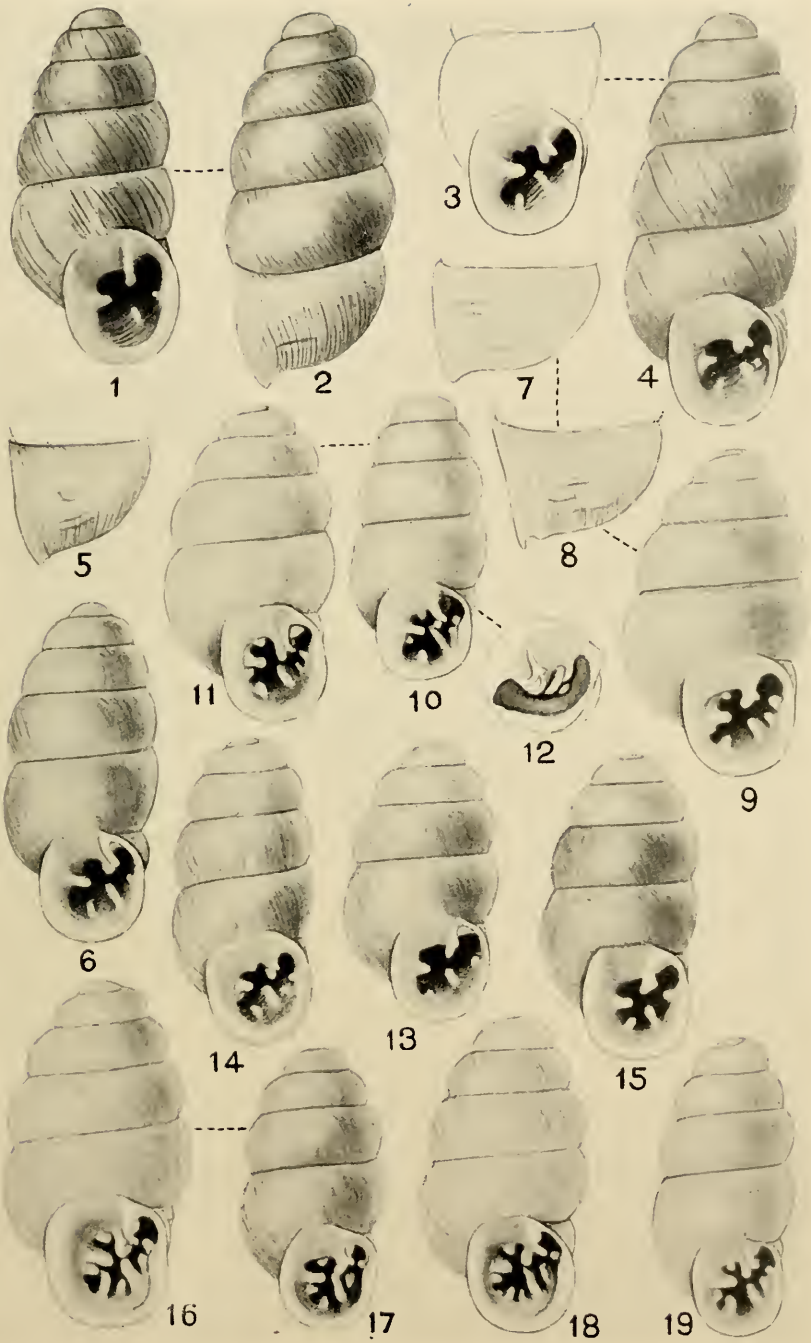
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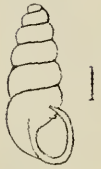
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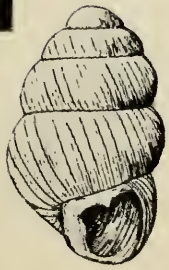
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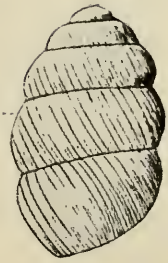
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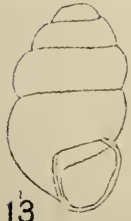
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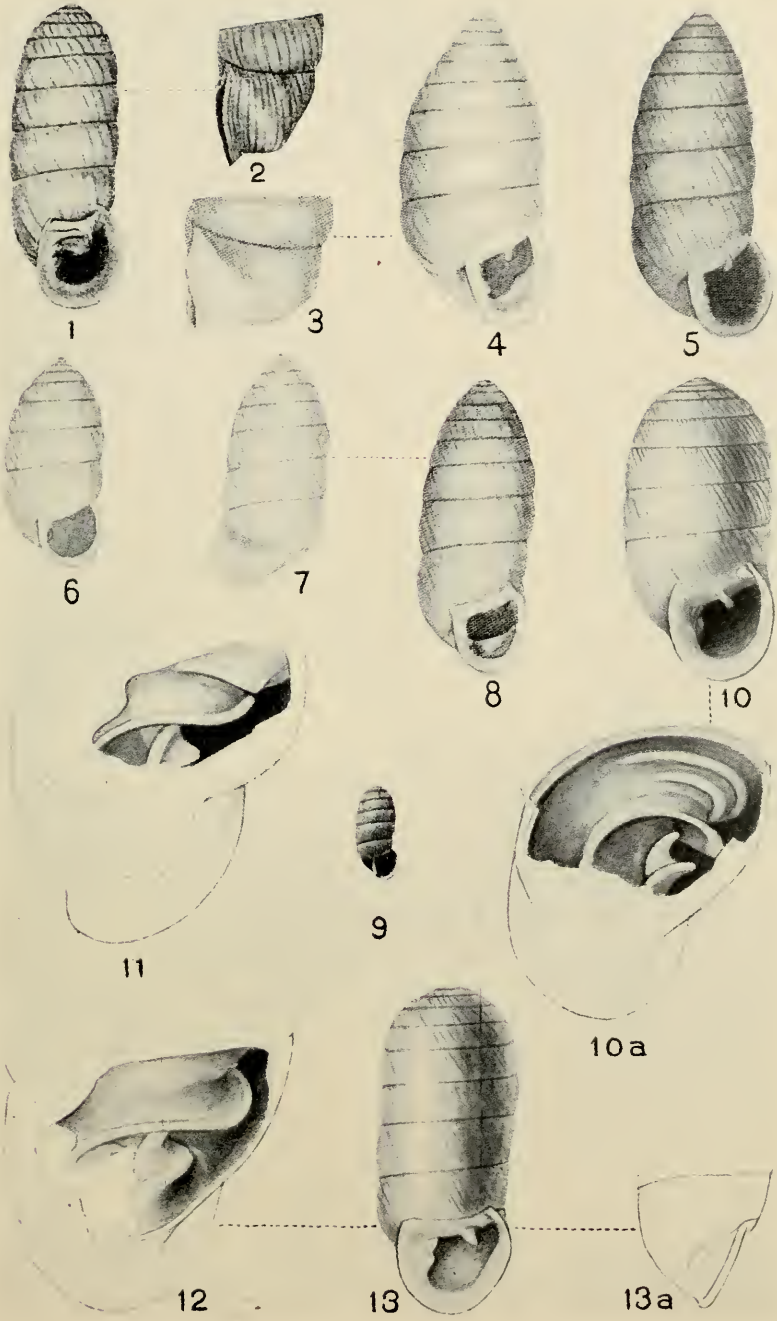
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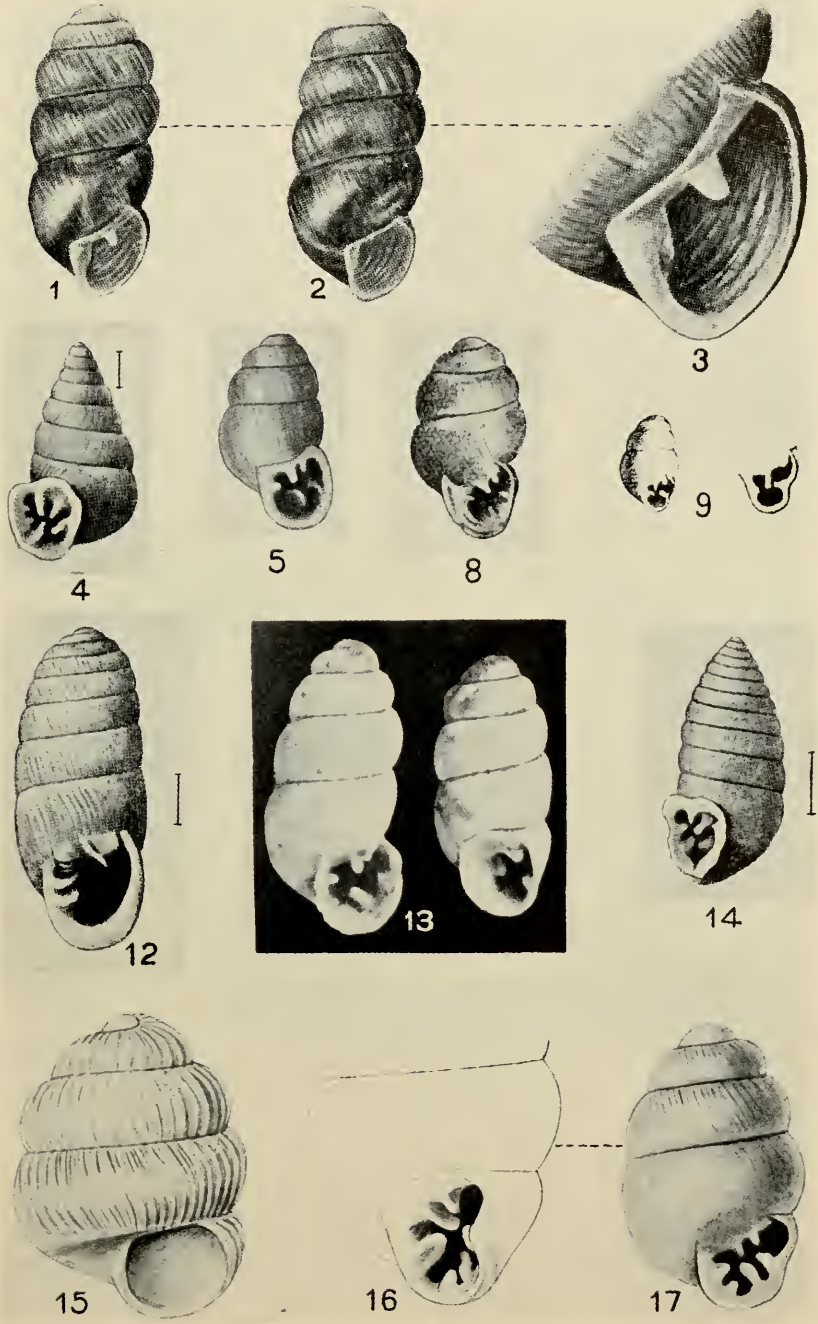
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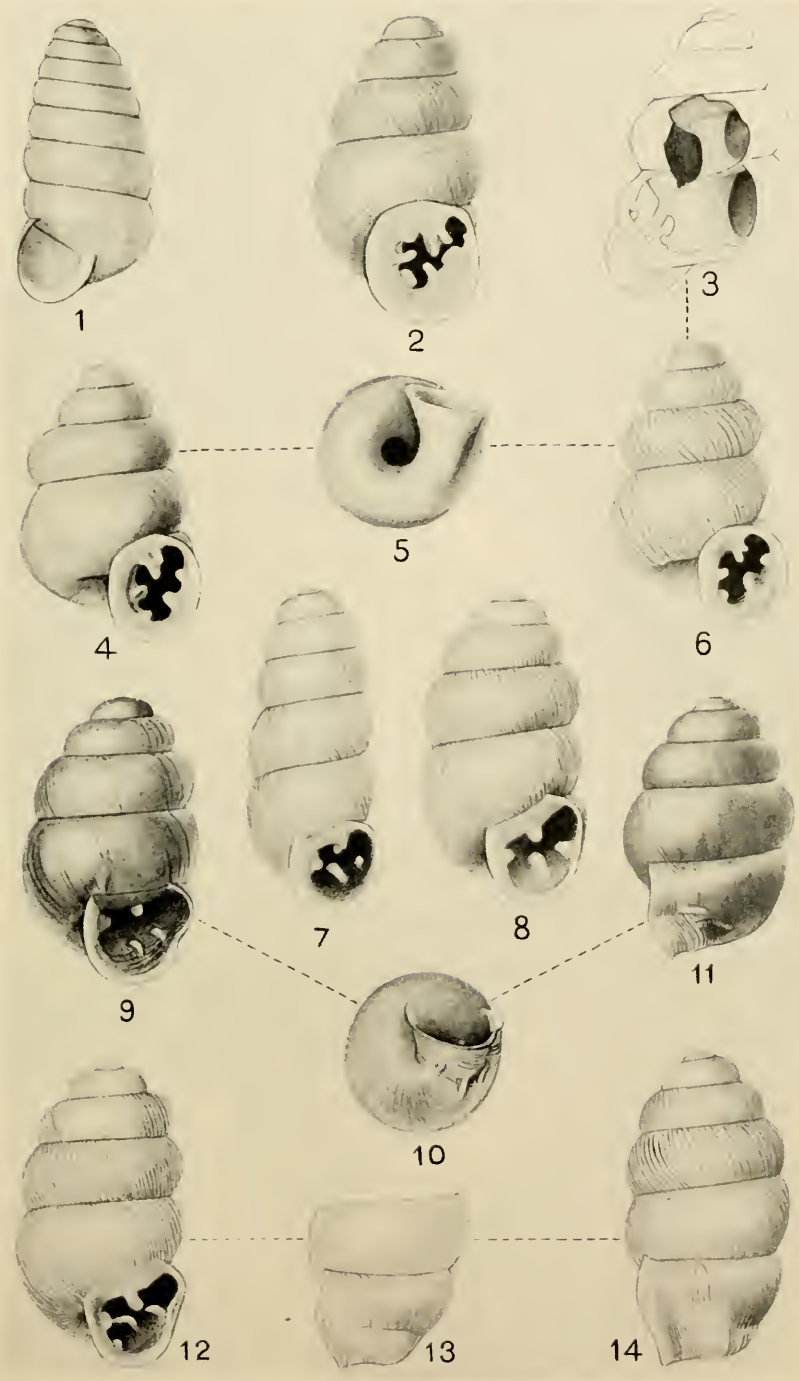
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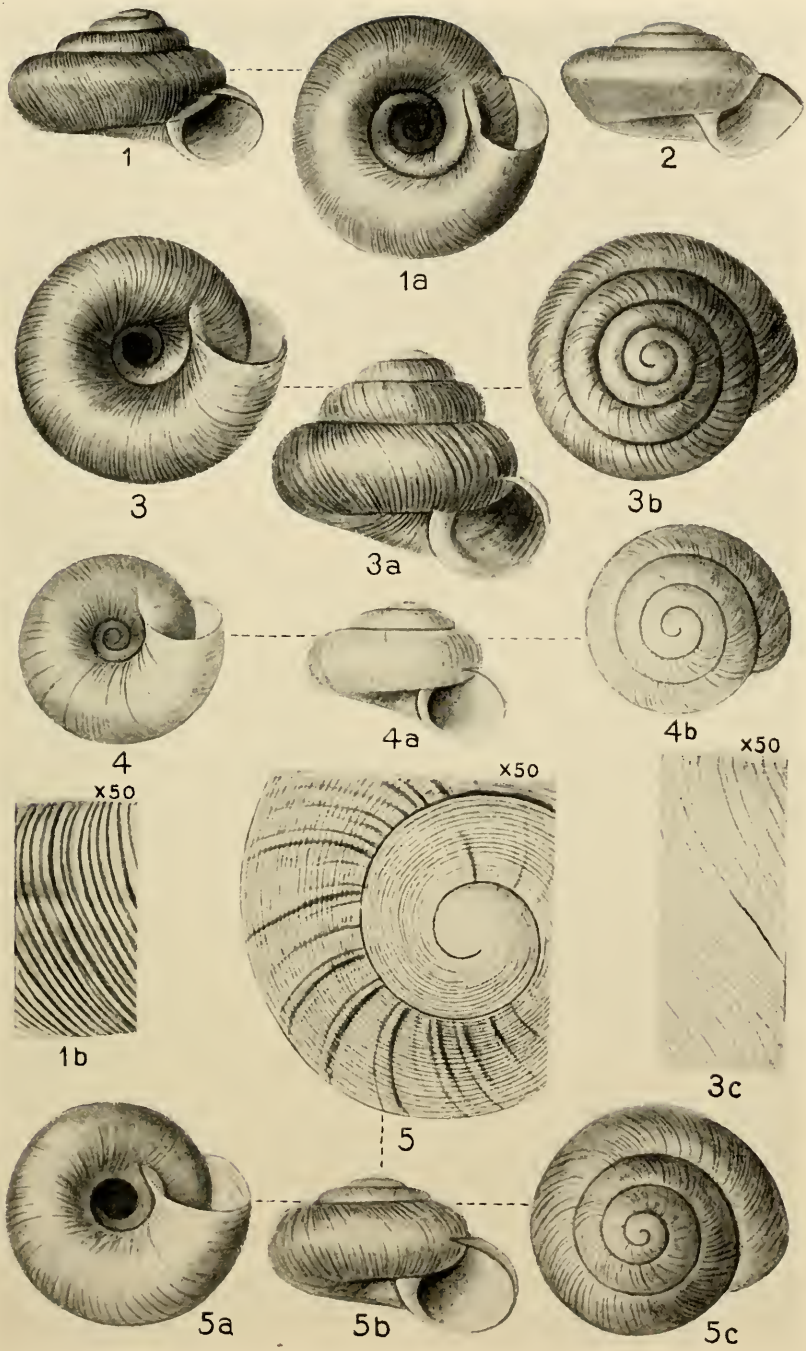
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L. m. percostata P. & C. 25:264. Oahu.
L. m. maunaloae P. & C. 25:264. Oahu, Molokai.
L. ovatula C. & P. 25:265. Oahu.
L. o. kona P. & C. 25:266. Hawaii.
L. o. moomomiensis P. & C. 27:225. Molokai.
L. plagioptyx P. & C. 25:267. Oahu.
L. cyrta C. & P. 25:268. Hawaii.
L. cubana Dall. 25:268. Kauai ?
L. thaumasia C. & P. 25:270. Kauai.

Nesopupa plicifera Anc. 25:280. Oahu.
N. waianaensis C. & P. 25:281. Oahu.
N. litoralis C. & P. 25:283. Oahu.
N. dispersa C. & P. 25:284. Oahu to Hawaii.
N. baldwini Anc. 25:287. Molokai, Maui, Hawaii.
N. b. subcostata P. & C. 25:288. Molokai.
N. b. lanaiensis P. & C. 25:289. Lanai.
N. limatula C. & P. 25:290. Maui.
N. dubitabilis C. & P. 25:291. Molokai.
N. d. kaalaensis C. & P. 25:292. Oahu.
N. anceyana C. & P. 25:293. Hawaii.
N. subcentralis C. & P. 25:294. Hawaii.
N. bishopi C. & P. 25:296. E. Maui.
N. forbesi C. & P. 25:297. Hawaii.
N. infrequens C. & P. 25:298. Kauai.
N. wesleyana Anc. 25:299. Oahu to Hawaii.
N. w. gouveiae C. & P. 25:301. Hawaii.
N. w. triphera C. & P. 25:301. Kauai, Oahu, Molokai.
N. w. rhadina C. & P. 25:301. Oahu, Molokai, Lanai.
N. w. kamaloensis P. & C. 25:303. Molokai.
N. thaanumi Anc. 25:304. Oahu, Lanai, Maui, Hawaii.
N. newcombi Pfr. 25:307. Kauai to Hawaii.
N. n. angusta P. & C. 25:315. Kauai.
N. n. interrupta C. & P. 25:315. Hawaii, Oahu.
N. n. disjuncta C. & P. 25:317. Oahu.
N. n. gnampta C. & P. 25:317. Oahu, Kauai.
N. oahuensis C. & P. 25:317. Oahu.
N. kauaiensis Anc. 25:318. Kauai.
N. singularis C. & P. 25:320. Oahu, Maui.
N. alloia C. & P. 25:321. Kauai.

Pronesopupa acanthinula Anc. 26:5. Oahu to Hawaii.
P. hystricella C. & P. 26:7. Hawaii to Kauai.
P. boettgeri C. & P. 26:8. Oahu.
P. b. spinigera C. & P. 26:10. Kauai to Hawaii.

P. admodesta Migh. 26:11. Oahu to Hawaii.
P. frondicola C. & P. 26:13. East Maui.
P. f. corticicola C. & P. 26:14. E. Maui.
P. molokaiensis C. & P. 26:15. Molokai.
P. incerta C. & P. 26-16. Kauai.
P. sericata C. & P. 26:17. Hawaii.
P. lymaniana C. & P. 26:18. Hawaii.
P. orycta C. & P. 26:18. Hawaii.

Pupisoma orcula Bens. 27:228; 28:116. Introduced Oahu; also Makatea, 28:116.

Columella sharpi Pils. & Cooke. 27:247. Hawaii.
C. olaaensis P. & C. 27:248. Hawaii.
C. alexanderi C. & P. 27:248. West Maui.

Nearctic and Neotropical Regions.

Though there are a good many species, the Americas are rather poor in genera of Pupillidae, and few of them are endemic. In the following list the names of subgenera are italicized.

Nearctic Region		Neotropical Region	
Temperate N. Am.	Mexico, C. Am.	West Indies	South America
.....	.....	.....	Gibbulina
Chaenaxis	.....	.....	.....
Gastrocopta *s. str.*	Gastrocopta *s. str.*	Gastrocopta *s. str.*	Gastrocopta *s. str.*
Immersidens	*Immersidens*	.....	*Immersidens*
.....	.....	.....	*Geminidens*
Albinula	*Albinula*	.....	.....
Vertigopsis	.....	.....	.....
Privatula	.....	.....	.....
Pupilla *s. str.*	Pupilla (?)	.....	.....
Striopupilla	.....	.....	.....
Pupoides *s. str.*	Pupoides *s. str.*	Pupoides *s. str.*	Pupoides *s. str.*
Ischnopupoides	*Ischnopupoides*	.....	*Ischnopupoides*
Vertigo *s. str.*	Vertigo *s. str.*	Vertigo *s. str.*	.....
Vertillopsis	.....	.....	.....
Angustula	*Angustula*	*Angustula*	.....
Columella	Columella	.....	.....
Sterkia *s. str.*[1]	.....	.....	.....
Metasterkia	*Metasterkia*	*Metasterkia*	*Metasterkia*
.....	Bothriopupa	Bothriopupa	Bothriopupa
.....	Nesopupa (Cocos I.)	.....	.....
Pupisoma[1]	Pupisoma	Pupisoma	Pupisoma
Zoögenetes	.....	.....	.....

[1] These genera occur only in the extreme southern edge of the Nearctic Realm and belong properly to the Neotropical.

Both genera and species are most numerous in the North Temperate Zone; going south the northern genera gradually drop out, until in Argentina only Gastrocopta remains; however, the South American Pupillidae are quite imperfectly known. In the tropics several genera are added, *Bothriopupa*, *Pupisoma* and *Sterkia*, the last two barely entering the lower border of the Nearctic Realm. The Cocos Island species referred to *Nesopupa* seems to be a stray from Polynesia, but it needs anatomic comparison with *Bothriopupa*.

The distribution shown in the table above apparently indicates successive invasions from Asia, which spread southward to distances determined by the date of introduction and the adaptability of the stocks. The gastrocopts and early vertigines apparently came in not later than Oligocene. The genera which presumably came later, such as *Pupilla* s. str., *Vertigo* s. str., *Columella* and *Zoögenetes*, differ but little from the old world forms or are specifically identical, and have made the least progress southward.

The only endemic American genera are *Gibbulina*, *Chaenaxis*, *Sterkia* and *Bothriopupa*. Endemic subgenera of *Gastrocopta* are: *Immersidens*, *Vertigopsis*, *Privatula* and *Geminidens*. *Pupilla* has the endemic subgenus *Striopupilla*; *Pupoides* the subgenus *Ischnopupoides*, and *Vertigo* the subgenera *Vertillopsis* and *Angustula*. Of the endemic genera, *Chaenaxis* and probably *Gibbulina* are derivatives of the *Gastrocopta* s. str. stock. I suspect that *Immersidens* came from the same stock, but pending anatomic evidence or other significant data, its place in the series remains uncertain. The folicolous *Bothriopupa* has the appearance of an Americanized *Nesopupa*, and from Dr. H. B. Baker's observations, agrees with that group anatomically. The terrestrial *Sterkia* may be presumed to be derived from some ancestral *Nesopupa*-like group which reached America from Asia, probably in Paleocene times.

Gastrocopta s. str., *Pupoides* and *Pupisoma* are common to the tropics of both hemispheres. *Pupoides* appeared in a practically typical species (vol. 27, p. 248) in the Upper Oligocene (Tampa silex bed) of Florida (at that time insular,

with an Antillean fauna). *Microcerion* (vol. 26, p. 151) from the same formation, is, in my opinion, a specialized tangent from *Microstele,* with which it agrees in all essential characters. The question arises, whether *Gastrocopta* s. str., *Pupoides* and *Microcerion* are traceable to Africa, over a translantic bridge which is believed to have existed in the Mesozoic and possibly later,[1] or whether they formed an early migration by the northern route.

United States northward; Lower California.

Chaenaxis tuba P. & F. 24:2. Arizona.
C. intuscostata Clapp. 24:3. Arizona.
C. i. brevicostata Pils. 24:4. Arizona.

Gastrocopta rupicola Say. 24:58. Southeastern U. S.
G. r. matacumbensis Pils. 24:6. Florida Keys.
G. procera Gld. 24:62. Eastern.
G. p. sterkiana Pils. 25:357; 27:207. S. Dakota to Texas.
duplicata Sterki. 24:65.
G. p. mcclungi H. & J. 24:66. S. Dakota south.
G. cristata Pils. & Van. 24:68. Texas to Arizona.
G. riograndensis Sterki. 24:69. Texas.
G. pellucida Pfr. 24:75. Southern States.
G. p. hordeacella Pils. 24:78; 28:117. Southern States.
G. p. parvidens Sterki. 24:80, 27:207. Arizona.
G. quadridens Pils. 24:57. Arizona, N. M.
G. (Albinula) armifera Say. 24:15. Eastern States.
G. (A.) a. similis Sterki. 24:17.
G. (A.) a. affinis Sterki. 24:18.
G. (A.) a. abbreviata Sterki. 24:18.
G. (A.) a. ruidosensis Ckll. 24:19. New Mexico.
G. (A.) a. clappi Sterki. 24:20.
G. (A.) contracta Say. 24:22. Eastern U. S. and Mexico.
G. (A.) c. peninsularis Pils. 24:24. Florida.
G. (A.) c. climeana Van. 24:24. Southern States.
G. (A.) holzingeri Sterki. 24:25. Eastern States.
G. (A.) h. agna P. & V. 24:26. Kansas.
G. (Vertigopsis) pentodon Say. 24:28. Eastern States.
G. (V.) p. gracilis Sterki. 24:31.
G. (V.) tappaniana C. B. Ad. 24:33. Eastern States.
G. (V.) carnegiei Sterki. 24:35. Ohio.

[1] *Cf.* Schuchert, "Gondwana Land Bridges", Bull. Geol. Soc. of America, vol. 43, p. 875. 1932.

G. (V.) pilsbryana Sterki. 24:36, 28:64. N. M. to Utah.
stoneri C. & J. 28:64.
G. (V.) p. amissidens Pils. 28:118. N. Arizona.
G. (Immersidens) perversa Sterki. 24:40. Arizona.
G. (I.) p. sana P. & F. 24:35.
G. (I.) p. minor Sterki. 24:44.
G. (I.) ashmuni Sterki. 24:41. Arizona.
G. (I.) a. imperfecta P. & F. 28:117.
G. (I.) cochisensis P. & F. 24:45. Arizona.
G. (I.) oligobasodon P. & F. 24:46. Arizona, New Mexico.
G. (I.) dalliana Sterki. 24:49. Arizona.
G. (I.) d. media Pils. 24:50. Arizona.
G. (I.) bilamellata Sterki & Clapp. 24:51. Arizona.
G. (I.) rixfordi Hanna. 27:207. Montserrate I., Gulf of Cal.
G. (Privatula) corticaria Say. 24:52. Eastern States.

Pupilla muscorum L. 26:156. Northern States.
P. blandi Mse. 26:159. Mountain States.
P. b. charlestonensis Pils. 26:163. Nevada.
P. sonorana Sterki. 26:163. Arizona.
P. hebes Anc. 26:164. Mountain States.
P. h. nefas P. & F. 26:166. Arizona.
P. syngenes Pils. 26:167. Mountain States.
P. s. dextroversa P. & V. 26:169.
P. s. avus P. & F. 26:171. Arizona.
P. (Striopupilla) sterkiana Pils. 26:156; 28:82. L. Cal.
P. (S.) goniodon Pils. 28:82. Guadalupe I., L. Cal.
P. (S.) guadalupensis Pils. 28:83. Guadalupe I., L. Cal.
Pupoides marginatus Say. 26:111, 27:249, 28:80.
P. modicus Gld. 26:115. S. Florida.
P. catalinensis Hanna. 27:249. L. California.
P. (Ischnopupoides) hordaceus Gabb. Arizona, New Mexico.
eupleura C. & B. 28:138. Utah.

Vertigo rugosula Sterki. 25:77. Southeastern States.
V. r. oralis Sterki. 25:78.
V. alabamensis Clapp. 25:79. Alabama.
V. a. conecuhensis Clapp. 25:80.
V. morsei Sterki. 25:81. Northeastern States.
V. ovata Say. 25:82, 372. Eastern and southern States.
V. o. diaboli Pils. 25:88. Texas.
V. o. mariposa Pils. 25:88. California.
V. o. santodomingensis Pils. 28:98.
V. berryi Pils. 25:89. California.
V. binneyana Sterki. 25:90. Rocky Mts.
V. ventricosa Morse. 25:94, 372. Northern States.

V. elatior Sterki. 25:95, 28:93. Northern States.
V. pygmaea Drap. 25:96. Northern States.
V. gouldii Binn. 25:98. Northern U. S. and Canada.
V. g. hubrichti Pils. 28:99. Missouri loess.
V. g. paradoxa Sterki. 25:99, 28:95. Northern.
V. g. cristata Sterki. 25:100. Canada.
V. g. coloradensis Ckll. 25:115. Colorado, Utah, Arizona.
V. g. basidens P. & V. 25:117. Rocky Mts.
V. g. arizonensis P. & V. 25:117. Arizona, New Mexico.
V. g. inserta Pils. 25:118. Arizona.
V. nylanderi Sterki. 25:100. Maine.
V. bollesiana Morse. 25:101. Northeast.
V. hebardi Van. 25:103, 372. Florida.
V. perryi Sterki. 25:103. Mass. and Rhode Island.
V. parvula Sterki. 25:105. Ohio.
V. tridentata Wolf. 25:106. Northern States.
V. columbiana Sterki. 25:108, 28:97. Northwestern States.
V. andrusiana Pils. 25:109. Northwestern States.
V. a sanbernardinensis Pils. 25:111. Southern California.
V. idahoensis Pils. 28:100. Idaho.
V. sterkii Pils. 25:112. California.
V. hannai Pils. 25:114. Kansas, loess.
V. wheeleri Pils. 28:96. Alabama.
V. concinnula Ckll. 25:119. Rocky Mts.
V. arthuri v. Marts. 25:121. North Dakota.
V. modesta Say. 25:123, 372. N. States to Alaska.
V. m. ultima Pils. 25:128. Alaska.
V. m. parietalis Anc. 25:128. Rocky Mts.
V. m. corpulenta Morse. 25:130. Rocky Mts.
V. m. insculpta Pils. 25:131. Arizona, New Mexico.
V. m. castanea Sterki. 25:132. California.
V. m. microphasma Berry. 25:376. S. California.
V. m. sculptilis Pils. 28:100. Montana, Oregon.
V. occidentalis Sterki. 25:134. S. California.
V. allyniana Berry. 25:376. S. California.
V. hoppii Moeller. 25:135, 27:216. Greenland.
V. dalliana Sterki. 25:137. California.
V. californica Rowell. 25:139. California.
V. c. trinotata Sterki. 25:140. California.
V. c. diegoensis Sterki. 25:141. S. California.
V. c. cyclops Sterki. 25:141. California.
V. c. longa Pils. 25:377. California.
elongata Sterki. 25:142.
V. c. catalinaria Sterki. 25:142, 28:97. Catalina I. south.
V. c. guadalupensis Pils. 28:97. Guadalupe I., L. Cal.

V. c. cupressicola Sterki. 25:143. Monterey, Cal.
V. rowelli Newc. 25:143, 378. Cal., Oregon.
V. degeneris Pils. 28:98. Guadalupe Is., L. Cal.
V. (Vertillopsis) oscariana Sterki. 25:144, 378. S. States.
V. (V.) hinkleyi Pils. 26:234. Arizona.
V. (Angustula) milium Gld. 25:146, 378. Eastern States.

Columella edentula Drp. 27:242. Northern States.
C. alticola Ingersoll. 27:243. Rocky Mts.
C. hasta Hanna. 27:245. Pleistocene, Kansas.

Sterkia rhoadsi Pils. 26:52. Florida.
S. clementina Sterki. 26:54. S. California.
S. hemphilli Sterki. 26:55. S. California.
S. calamitosa Pils. 26:57. L. California.
S. c. martiniana Pils. 28:110. L. California.

Bothriopupa variolosa Gld. 24:230. S. Florida.

Pupisoma dioscoricola C. B. Ad. 26:37, 235. S. Florida, Texas.
P. minus Pils. 26:40. Florida.
P. macneilli Clapp. 26:41. S. Alabama.

Zoögenetes harpa Say. 27:196. Northeastern and Canada.

Pupillidae of Mexico and Central America.

Gastrocopta servilis Gld. 24:70. Mexico to Panama.
G. pellucida Pfr. 24:75. Eastern Mexico.
G. (Immersidens) prototypus Pils. 24:47. Mexico.
G. (I.) p. basidentata Pils. 24:48. Guatemala.
G. (Albinula) contracta Say. 24:22. Eastern Mexico.

Pupilla (?) oerstedi Moerch. 28:82. Nicaragua.

Pupoides marginatus Say. 26:111. N. E. Mexico.
P. (Ischnopupoides) chordatus Pfr. 26:119. W. Mexico.

Sterkia eyriesii Drt. 26:51. Guatemala.
S. bakeri Pils. 26:236. Southern Vera Cruz.

Vertigo ovata Say. 25:82. E. Mexico.
V. (Angustula) milium Gld. 25:146. E. Mexico.

Columella polvonensis Pils. 27:246. Nicaragua.

Nesopupa cocosensis Dall. 25:323. Cocos I., C. R.

Bothriopupa breviconus Pils. 24:230. Guatemala.
B. leucodon Morel. 24:232. Guatemala.

Pupisoma dioscoricola C. B. Ad. 26:37. Yucatan.
P. minus Pils. 26:40. Guatemala.

P. comicolense H. B. Bkr. 28:115. State of Puebla.
P. mediamericanum Pils. 26:42. E. Mexico, Guatemala.
P. michoacanense Pils. 26:40. Michoacan, Mex.
P. bailyi Pils. 28:116. Cuernavaca, Mexico.

West Indies and Bermuda.

Gastrocopta rupicola Say. 24:57. Bahamas, Bermuda.
G. r. duplex Pils. 24:60. Bermuda.
G. r. marginalba Pfr. 24:60. Cuba, etc.
G. servilis Gld. 24:70. Generally distributed.
G. s. riisei Pfr. 24:74.
G. pellucida Pfr. 24:75. Generally distributed.
G. p. biminiensis Pils. 24:78. Bahamas.
G. p. delicata Pils. 24:78. Bahamas.
G. barbadensis Pfr. 24:83. Generally distributed.
G. b. crassilabris Pfr. 24:85. Bahamas, Bermuda.
G. b. hojeda Pils. 27:206. Curacao.
G. polyptyx Pils. 24:89. St. Thomas to Bermuda.
G. curacoana Pils. 27:202. Curacao.
longurio Crosse. 24:82.
G. octonaria Pils. 27:204. Curacao.

Pupoides marginata Say. 26:111.
P. m. nitidula Pfr. 26:113; 27:250.
P. coenopicta Hutt. 26:123. Cuba, Porto Rico.

Vertigo marki Gul. 25:107. Bermuda.
V. numellata Gul. 25:91. Bermuda.
V. ovata Say. 25:82.
V. torrei Aguayo & Jaume. 28:98. Cuba.
V. gouldii Binn. 25:98.
V. (Angustula) milium Gld. 25:146; 28:101.
V. (A.) bermudensis Pils. 25:149. Bermuda.

Sterkia antillensis Pils. 26:53.

Bothriopupa tenuidens C. B. Ad. 24:227.

Pupisoma dioscoricola C. B. A. 26:36.
P. minus Pils. 26:40.

"Pupa" lata C. B. Ad. 28:135. Jamaica.

South American Pupillidae.

Gibbulina infundibuliformis Orb. 24:6. Bolivia.

Gastrocopta barbadensis solitaria Sm. 24:88. Fernando Noronha.

G. servilis oblonga Pfr. 24:90. Brazil.
G. miliola Orb. 24:92. Brazil.
G. microdonta Doer. 24:92. Argentina.
G. clessini Doer. 24:93. Argentina.
G. nodosaria Orb. 24:94. Bolivia.
G. wolfi Mill. 24:94, 27:208; 28:117. Ecuador.
G. munita Reib. 24:96, 357; 28:64. Galápagos.
G. duncana Pils. 28:65. Duncan I., Galápagos.
G. clausa Reib. 24:99, 357; 28:69. Galápagos.
G. (Immersidens) dicrodonta Doer. 24:100. Argentina.
G. (I.) iheringi Suter. 24:101. Brazil.
G. (I.) pazi Hid. 24:102; 28:64. Peru.
G. (I.) colombiana Pils. 26:228. Colombia.
G. (Geminidens) geminidens Pils. 24:228; 27:202. Venezuela.

Pupoides simoni Jouss. 26:114. Venezuela.
P. (Ischnopupoides) paredesii Orb. 26:120. Peru, Bolivia.

Sterkia eyriesii Drt. 26:51. Guyana to Guatemala.

Bothriopupa tenuidens C. B. Ad. 24:229. Venezuela.
B. conoidea Newc. 24:231. Venezuela.
B. peruviana Pils. 28:114. Peru.

Pupisoma dioscoricola C. B. Ad. 26:36; 28:114. Brazil, Galápagos.
P. galapagorum Pils. 28:114. Galápagos.
"Pupa" plusiodonta Holmb. 25:67. Argentina (?).

Appendix to Pupillidae.

Gastrocopta jeanneli Germain.

Shell sinistral, a little shortly pupoid, umbilicate. Spire of 5 convex whorls, regularly and quite rapidly increasing, the last large, very convexly ventricose; suture rather deep. Summit obtuse, smooth. Aperture subvertical, semioval, with separated, slightly converging margins, united by a very thin callus, with a small, oblique, lamellar parietal fold nearer to the upper insertion, and a small palatal denticle, hardly noticeable, in the middle of the outer margin. Peristome thick, especially in the middle part, white; columellar margin obliquely subrectilinear, dilated, yellowish white. The shell is yellowish amber, glossy, subtransparent, sculptured with longitudinal, oblique, subundulating striae which are unequal,

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quite fine and irregularly spaced, readily visible to the umbilicus, less crowded on the upper whorls than on the last; the embryonic whorls smooth. Length 2.5 mm., diam. 1.6 mm., height aperture 1.1 mm., width 1 mm. (*Germain*).

Kilima Njaro, in upper margin of the forest at Bismarck Hill, between 2700 and 2800 meters (Ch. Alluaud and R. Jeannel).

Gastrocopta jeanneli Germain, Bull. Mus. Nat. d'Hist. Nat. (2), vol. 6, June, 1934, p. 381.

Lauria alluaudi Germain.

Shell subconic, formed of 6½ quite convex whorls, increasing slowly, the last moderate. Suture somewhat deep, marginate. Aperture pyriform oval, quite angular above, the margins converging very little and quite remote, with a strong projecting lamellar parietal tooth and a very small supraparietal nodosity. Peristome slightly thick (the thickening more accentuated in the middle of the outer margin); columellar margin dilated. The shell is yellowish chestnut; sculptured with longitudinal oblique unequal striae, quite strong but not lamellar. Length 3 to 3.25 mm., diam. max. 1.5 to 1.7 mm.; height aperture 1.3 to 1.5 mm. (*Germain*).

Mt. Kinangop, alpine prairies at 3100 meters (Ch. Alluaud and R. Jeannel).

Lauria alluaudi Germain, Bull. Mus. Nat. d'Hist. Nat. (2), vol. 6, p. 382, June, 1934.

Lauria karisimbiensis, new species. Pl. 25, figs. 2, 3.

The shell is umbilicate, ovate, tapering from the last whorl to the obtuse apex, the lateral outlines convex; cinnamon-buff, subtranslucent, rather glossy, marked with weak, unequal lines of growth. The whorls are rather weakly convex, the last rounded at base, curving into the moderately large umbilicus. The peristome is whitish, the outer margin becoming well expanded in its lower part, basal margin built forward and subreflected. Parietal margin bearing a very small lamella situated on the right side of the middle, and extending inward a short distance (about 0.4 mm.), its inner half being very low. Length 3.3 mm., diam. 2 mm.; 5½ whorls.

Belgian Congo: Camp Lukumi, Mt. Karisimbi (north of Lake Kivu), at 11,370 ft., in moss in the subalpine heather zone. Type 77267 M. C. Z., coll. by Dr. Jos. Bequaert.

By the wide removal of the angular lamella towards the middle of the parietal margin, from its usual position near the posterior angle, this species resembled *L. borbonensis* Pils. and *L. desiderata* Preston (vol. 27, p. 62). It appears to be closely related to the latter, which occurred on Mt. Kenya at 9,000 to 10,000 ft., but it differs by the very small size of the angular lamella, which is more reduced than in any other *Lauria*, and by the less oblique columella margin. I have not been able to compare a specimen of *L. desiderata*, but its habitat is remote from that of our species. The relatively large umbilicus of *L. karisimbiensis* is one of its notable features.

L. bequaerti Pils (this vol., p. 138) is very different, being larger with a strongly developed angular lamella connected with the outer lip. *L. alluaudi* according to the description differs by possessing a strong tooth on the parietal wall, and it has one turn more in a shell of the same or smaller size.

TRUNCATELLINA FLAVOGILVA Germain.

Shell subcylindric, the spire formed of 7 quite convex whorls of regular increase, the penult very convex, developed in width, the last moderate, suture deep. Summit obtuse, flattened. Almost no umbilicus at the bottom of a funnel-shaped cavity. Aperture semioval, but little oblique, not toothed, the separated margins joined by an inconspicuous callus. Peristome white, thick, slightly reflected, the columellar margin obliquely arched, white. The shell is a little grayish yellowish. Embryonic whorls very finely striate, the others sculptured with oblique, subundulating and very close longitudinal riblets. Length 1.5 mm. (*Germain*).

Massif of Kilima Njaro: Neu Moschi, a post on the Rau river at the foot of the south slope of the mountain, at 800 meters (Ch. Alluaud and R. Jeannel).

Truncatellina flavogilva GERMAIN, Bull. Mus. Nat. d'Hist. Nat. (2), vol. 6, p. 381, June, 1934.

COLUMELLA NINAGONGONIS, new species. Pl. 25, fig. 1.

The thin shell is deeply rimate, cylindric in the lower half, slowly tapering in the upper, to the very obtuse apex, the lateral outlines being convex; light isabella color, fading to pale gray on the first two whorls. The whorls are short and strongly convex, the suture rather deeply impressed. Sculpture of weak lines of growth, the first two whorls microscopically punctate. The aperture is short, a little longer than wide. Peristome whitish, the outer margin rather strongly curved and thin posteriorly, anteriorly becoming well expanded, together with the basal and columellar margins. Length 1.9 mm., diam. 0.8 mm., length aperture 0.5 mm.; 7 whorls.

Belgian Congo: Mt. Ninagongo (north of Lake Kivu), in moss of mountain forest at 9000 ft. Type 77268 M. C. Z., coll. by Dr. J. Bequaert, Harvard African Exped. 1926-7; paratype A. N. S. P.

The only nearly related species known is *C. pygmaeorum* Pils. & Ckll. (see p. 109), which is sinistral, a little larger and with the outer lip less arcuate above.

The following names were listed in Servain, Oeuvres Scientifiques de M. J. R. Bourguignat, 1891 (not seen by H. P.). The list has been reproduced by M. Connolly, 1934, Proc. Malac. Soc. London, vol. 21, p. 72. All appear to be nude names.

Sphyradium adamii Bgt. Italy.
Orcula desertorum Bgt. Syria.
hellenica Bgt. Greece.
helvetica Bgt. Switzerland.
mabilleana Bgt. Greece.
pyrgula Bgt. Syria.
rapula Bgt. Syria.
scytoidea Bgt. Anatolia.

Orcula helvetica Bgt. is listed by Connolly as described by Westerlund, Fauna Europaea, p. 198. The form described in that place is [*Pupa alpestris*] "var. *helvetica* mh.", not the *Orcula* of Bourguignat. Westerlund did not ascribe it to

Bourguignat, but expressly claimed it himself. It is a *Vertigo* (vol. 25, p. 201).

Pupa orcutti Pilsbry was mentioned by C. R. Orcutt (West American Scientist VII, Oct. 1891, p. 270) as from near San Quentin Bay, Lower California, on lichens. It is a nude name. I have no record or recollection of this species, but it was probably one of those described later from the same region.

Family VALLONIIDAE.

Valloniidae PILSBRY, 1900, Proc. A. N. S., Phila., p. 564.

Acanthinulinae PILSBRY, 1918, Man. Conch., vol. 24, p. x; 27, p. 186.

Acanthinulidae STEENBERG, 1918, Vidensk. Medd. Dansk. Naturh. Foren., vol. 60, p. 14.

Valloniinae WATSON, 1920, Proc. Malac. Soc. Lond., vol. 14, p. 6.

Minute orthurethrous snails with perforate or umbilicate shells of few whorls, from discoidal to ovate-conic in form, often with spaced cuticular ribs, and without internal laminae; the peristome either expanded, thickened or simple; toothless (except in *Spelaeodiscus*).

The oviparous or viviparous animal has a long penial appendix; the retractor muscle forked (except in *Planogyra*). The prostate gland is short and posterior. As in many other unrelated genera of minute orthurethous snails, the terminal male organs are often wanting. The arcuate jaw is thin, with weak, flat vertical folds. Central tooth somewhat or decidedly narrower than the laterals, tricuspid or with ectocones much reduced. Lateral teeth bicuspid; marginal teeth wide, pectinate, with several or numerous narrow cusps.

This group is understood in the limits of Steenberg and Watson except that the genera *Pyramidula* and *Pleurodiscus* are excluded.

The character of being toothless has not, I think, been sufficiently appreciated by those who would unite Valloniidae with the Pupillidae or the Strobilopsidae. Two leading genera, *Vallonia* and *Acanthinula*, are known in many species from

the early or middle Paleocene to the present time, without showing traces of teeth or internal laminae. The only toothed member of the family is *Spelaeodiscus*, and here the teeth are not at all of Pupillid type, being more like the apertural teeth which have arisen in various stocks of helices.

VALLONIA Risso.

Vallonia Risso, 1826, Hist. Nat. Eur. Mérid. vol. 4, p. 101, sole species *V. rosalia* Risso = *V. costata* Müll.

Amplexis Brown, 1827, Illust. Conch. Gt. Brit. and Ireland, expl. pl. 41, for *A. paludosus* (= *V. pulchella*) and *A. crenellus* (= *V. costata*) ; A. *paludosus* here selected as type.

Amplexus Brown, 1844, Illust. Conch. G. B. and Irel. (2), p. 45, for *Helix pulchella* and *H. crenella.* Not of Sowerby, 1815.

Zurama Leach, in Turton, 1831, Man. Land and Freshwater Shells Brit. Is. p. 64, in synon. under *Helix pulchella.* Quoted as *Zuramia* Leach by Kennard & Woodward, 1926, Syn. Brit. Non-mar. Moll. p. 135, in synon.

Circinaria Beck, 1837, p. 23, in part.—Herrmannsen, Mar., 1847, Ind. Gen. Malac. vol. 1, p. 237, *Helix pulchella* selected as type.

Glaphyra Albers, 1850, Die Hel. p. 87, for *Helix tuckeri, pulchella* and *costata*; *H. pulchella* here selected as type.

Lucena "Hartmann", Gray, 1840, in Turton's Manual, p. 142.—Moquin-Tandon, 1855, Moll. France, vol. 2, p. 140, for *H. pulchella.* Not *Lucena* Hartmann, 1821, Neue Alpina I, 208, 245.

Valtonia Kisse, Ancey, 1881, Le Naturaliste, vol. 1, p. 215, for *H. pulchella* (typographical errors).

Lurama Leach, Honigmann, 1910, Abh. u. Ber. Mus. für Natur- u. Heimatsk. u. Naturw. Ver. Magdeburg, vol. 2, p. 43 for *L. pulchella* (typog. err.).

Vol. 8, pp. 247-261. For notes on anatomy see p. 195, pl. 29, fig. 1, *V. pulchella* (Müll.).

ACANTHINULA Beck.

Vol. 27, p. 188. See also p. 196, where some account of the anatomy is given. Pl. 29, fig. 6, genitalia of *A. aculeata,* after Steenberg.

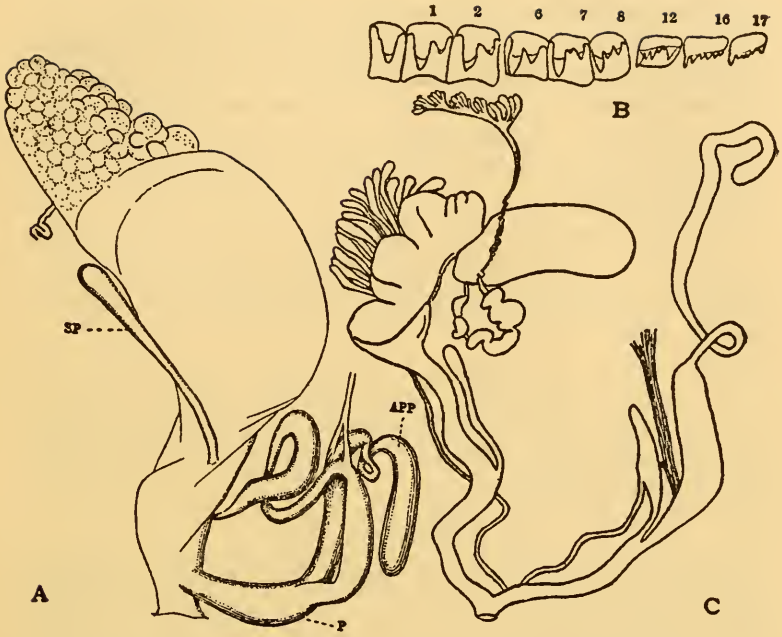

Fig. 9. A, Zoögenetes harpa. B, C, Spelaeodiscus triarius.

ZOÖGENETES Morse.

Vol. 27, p. 195. Steenberg (1925, pl. 29) has figured the genitalia of an individual without male terminal organs. In a specimen from High Pines, Duxbury, Massachusetts, taken in September, 1911, I found the penis fully developed and the uterus containing embryos (fig. 9a.).

The kidney has the pouch-like form usual in Pupillidae, the walls of its large cavity having about ten unequal longitudinal ridges. Orthureter long, direct, opening in the lung some distance from the collar. It is heavily pigmented toward the anterior end, which appears externally as an oblong black spot.

The penis is rather thick and bears a long appendix enlarged distally, narrowed in the middle. Epiphallus rather thick, without a flagellum. The bifid retractor muscle is in-

serted on epiphallus and appendix. The prostate gland is small and posterior. The spermoviduct is strongly convoluted. Albumen gland multilobular. Uterus much distended by the contained embryos, its neck much shorter than the vaginal part of the oviduct. Spermatheca is oblong, but little larger than its duct, which is of medium length, without diverticulum.

Zoögenetes differs from *Acanthinula* chiefly by the absence of appendages on the epiphallus, the shorter spermathecal duct and the viviparous reproduction. It is more like *Vallonia* in the genitalia.

SPERMODEA Westerl.

Vol. 27, p. 186. Specimens possessing the penis have not yet been dissected. Without it, the position of the genus can not be closely estimated.

PLANOGYRA Morse.

Man. Conch. vol. 9, p. 45. Dr. H. Burrington Baker has shown that this genus is related to *Acanthinula*. See page 197, pl. 26, figs. 1-3.

Genus SPELAEODISCUS Brusina.

Vol. 27, p. 180. This genus was associated with *Pagodulina* on account of some slight similarities in the shells. The anatomical work and figures of Soos (1917, p. 65, figs. 39-42), partly reproduced here, p. 175, figs. 9 *b, c,* show a long appendix, contracted in the middle, as in various Valloniidae. There is a thick "flagellum", and the penial retractor is forked. The spermathecal duct is short, as in *Vallonia* and *Zoögenetes*. The prostate gland, composed of very long tubules, shows unusually strong development.

Steenberg (1925, pp. 184, 202) suggests a subfamily Spelaeodiscinae, which he includes with some doubt in the Valloniidae. Watson (1920) judging by the figures of Soos, considered the genus allied to *Vallonia* and *Acanthinula*. This position appears to me to be logical. The resemblance of *Spelaeodiscus* to *Strobilops* mentioned by H. B. Baker seems

to me a secondary and superficial one, as the former does not share the essential character of *Strobilops*, which is the possession of a system of internal laminae from a very early stage to the adult.

Pagodulina (Vol. 27, p. 166) has not been dissected by any recent investigator. The figure of Moquin-Tandon, as far as it goes, agrees with *Orcula* in form of penis and appendix, as pointed out by Steenberg (1925).

Family PLEURODISCIDAE.

Pleurodiscidae Wenz, 1923, Fossilium Catalogus, Pars 21, p. 1069.

Patulastridae (*Pleurodiscidae*) Steenberg, 1925, Vidensk. Medd. Dansk. Naturh. Foren. i Kobenh. vol. 185, 202.

The shell is umbilicate, discoidal or turbinate, closely costulate or striate, the peristome simple and sharp.

The viviparous animal has simple male end organs, the passage of penis into epiphallus marked by an abrupt contraction, the simple penial retractor inserted on epiphallus; no appendix or flagellum. The spermathecal duct is of medium length (*Pleurodiscus*) or short (*Pyramidula*), and not forked. Jaw and teeth substantially as in Valloniidae.

Two Palaearctic genera grouped together in this family are not closely related, but they agree in the simplicity of the male organs, and are not strikingly unlike in the shells. To include them in the Valloniidae would destroy the reasonably homogeneous character of that group.

Genera of Pupillidae without penial accessories have been regarded as secondarily simplified end-products of evolution, on account of their close relationship by the shell and other qualities with genitally complicated genera (this vol., Introduction), as in the case of *Vertigo* and *Nesopupa*. I can not see any stem in the Valloniidae which will serve as a plausible support for the attachment of *Pleurodiscus* and *Pyramidula* thereto as simplified branches.

Dr. H. B. Baker suggests that the Pyramidulinae and Pleurodiscinae may represent primitive conditions, before the evolution of complex genitalia (this vol., p. 193). In that

case their divergence from the common stem of the other groups must have been prior to the branching out of the Achatinellidae, Tornatellinidae, Pupillidae, Valloniidae etc., all of which had acquired similar penial complications before the parting of their several ways.

On the whole, the inclusion of Pleurodiscidae in Valloniidae appears to be without satisfactory basis. That classification was apparently prompted by a desire to restrict the number of families. I see no advantage in claiming a relationship which involves so many difficulties.

1. Shell of moderate size, discoidal; penis very short, with apical papilla through which the long, internally ridged epiphallus enters; prostate gland long, about equal to the uterus; spermathecal duct moderately long (Pleurodiscinae) Genus *Pleurodiscus* Wenz.

2. Shell minute, depressed conic or turbinate; penis abruptly terminated; prostate gland short, posterior; spermathecal duct short. (Pyramidulinae) Genus *Pyramidula* Fitz.

Genus PLEURODISCUS Wenz.

Pleurodiscus Wenz, 1919, Nachrbl. Deutsch. Malak. Ges. vol. 51, p. 778, type *Goniodiscus* (*Pleurodiscus*) *balmei* (Pot. et Mich.).

Helix, Patula and *Patulastra* of some authors; not *Patulastra* Pfeiffer as restricted to "*Patula*" *pygmaea* Drap. by Kobelt, 1880, Ill. Conchylienbuch p. 231.

For anatomy see Hugh Watson, Proc. Malac. Soc. Lond. vol. 14, p. 6.

The shell is *Discus*-like, openly umbilicate, depressed, of 5½ to 6 whorls, the apical 2½ smooth, the rest costulate. Aperture lunate; peristome sharp, somewhat dilated at the columella.

The jaw is thin, closely striate, the edges of the folds slightly free (Man. Conch. IX, pl. 15, f. 2). Radula of *P. balmei* with 17-9-1-9-17 teeth. Central tricuspid, smaller than the laterals, which are bicuspid. Marginals wide, pectinate.

Reproduction ovo-viviparous. Penis very short, the epiphallus entering through a short blunt papilla. Epiphallus

long, the penial retractor inserted on it. No penial appendix, but the epiphallus has internal complications in the form of spiral ridges. Spermathecal duct long. Prostate gland about as long as the uterus, composed of many narrow, separate tubules (Pl. 29, figs. 3-5, after Watson).

This very distinct genus comprises a few species distributed around the eastern basin of the Mediterranean. They are closely similar, and possibly not specifically distinct, but only the Sicilian *P. balmei* has been dissected. Wenz (Fossilium Catalogus part 21, pp. 1069-1071) recognized three or four middle European Tertiary species as follows:

Pleurodiscus falciferus (Bttg.), *Helix* (*Patula*) *falcifera* Boettger, 1870. Upper Miocene, Aquitanian, near Ulm; Burdigalian, Tuchorschitz. Said to be the same as *P. orbicularis*.

P. frici (Klika), *Patula* (*Anguispira*) *frici* Klika, 1891. Upper Oligocene, Wärzen, Czechoslovakia.

P. mamillatus (Andreae), *Pyramidula mamillata* Andreae, 1904. Upper Miocene, Oppeln.

P. orbicularis (Klein), *Helix orbicularis* Klein, 1846. Upper Miocene, near Ulm.

Pleurodiscus balmei (Pot. & Mich.). Plate 25, fig. 15.

The shell is depressed with convex spire, umbilicate, the umbilicus contained about 4½ times in the diameter, somewhat well-like, contracting but slowly within. Whorls convex, slowly increasing, the last rounded; suture deeply impressed. Buff, the base pale or whitish. The apical 2½ whorls are nearly smooth and glossy; following whorls dull, rib-striate, the riblets narrow, 3 to 4 in one mm. on the last whorl, a few fine striae in the intervals. Aperture but slightly oblique. Peristome thin, blunt, the basal margin straightened or slightly curving forward, columellar margin dilated.

Height 5.5 mm., diam. 9.5 mm.; 5⅔ whorls.

Height 6.3 mm., diam. 11 mm.; 6 whorls.

Sicily: Monte Pellegrino, near Palermo, type loc.; Malta (Caruana); Sardinia near Laconi; Italy at Reggio in Calabria; Algeria.

Helix balmei Potiez et Michaud, 1838, Galerie Moll. de Douai, I, p. 120. Paulucci, 1879, Journ. de Conch. vol. 27, p. 7. Westerlund, 1889, Fauna Pal. Reg. Binnenconch, Helix p. 13.—*Helix flavida* Zgl. Rossmaessler, 1839, Iconogr. vol. 2, p. 13, f. 610.—Pfeiffer, Mon. Hel. Viv. vol. 1, p. 144.—*Helix flavescens* Parreyss in coll., Rossmaessler, 1839, *l. c.*, as syn. of *H. flavida.*—*Helix teresae* Benoit, 1845, Ricerche Malacologiche, p. 9, pl. 2, f. 5 *a*, *b*. (Palermo, Cephalu, Siracusa etc.).

Rossmaessler's good figures were copied by Tryon in M. C. vol. 3, pl. 6, figs. 48-50. Potiez and Michaud's description and dimensions (7-8 x 12-14 mm.) were so ambiguous that though often discussed, no one recognized that the well-known *H. flavida* was intended until Mme. Paulucci examined the types in 1879. It was a pity to displace the well-defined name *flavida.*

Pleurodiscus erdeli (Roth). Pl. 25, fig. 16.

Shell widely umbilicate, depressed, elegantly costulate, pellucid, buff-corneous, paler beneath. Whorls rounded. Aperture transversely lunate-ovate; peristome straight, simple, flexuous. Alt. 2⅓, diam. 3⅔ lines; 5 whorls. Differs from *H. ruderata* Stud. by the size, the narrower umbilicus and more depressed aperture (*Roth*).

Rhodes, type loc., Roth; Syria at Beirut; Palestine; Asia Minor; Constantinople.

Helix erdelii Roth, 1839, Moll. Species in Itinere per Orientem facto, etc., p. 16, pl. 1, f. 4, 5, 20.—Pfeiffer, Monogr. I, p. 105.

I have not seen specimens from Rhodes. A Beirut example figured measures height 6.1 mm., diam. 10.7 mm.; barely 6 whorls. It is cinnamon-buff, the umbilicus noticeably wider than in *P. balmei*, more perspective. In the aperture a white callus lining is seen, stronger than in *P. balmei*, of which some authors consider *erdeli* a variety. It was named for Dr. M. Erdl, Roth's travelling companion in the Orient.

It has been recorded from Malta by Issel (1868, Bull. Malac. Ital. I, p. 5, the specimens identified by Bourguignat).

Maltese shells I have seen do not seem to differ from Sicilian *balmei*.

PLEURODISCUS SUDENSIS (Pfr.). Pl. 25, fig. 14.

Shell umbilicate, depressed, regularly and closely costulate, thin, diaphanous, reddish-corneous; spire slightly elevated; whorls 6, convex, the last not descending; umbilicus rather large, perspective; aperture rotund-lunate; peristome simple, acute, columellar margin slightly dilated, shortly spreading. Alt. 7, diam. 13 x 11.5 mm. (*Pfr.*).

Crete: Suda, type loc.; Candia; Akrotini; all in the northwest part of the island.

Helix sudensis PFEIFFER, 1846, Symbolae Hist. Hel. III, p. 103.—ROSSMAESSLER, Iconogr. L. u. Süsswasser Moll. Eur. III, p. 85, f. 901.

The color is "pinkish-buff", a little browner than *P. balmei*. The umbilicus is contained 4½ times in the diameter. Apical whorls as in *P. balmei*. The shell is larger than *balmei*, with about half a whorl less. The last whorl is relatively a little wider and less depressed, the basal margin of the peristome a little more deeply arcuate. The riblets are slightly closer; finally, the white callous lining of the last whorl occupies more space than in *balmei*, about one-sixth of the base. A specimen from Akrotini figured measures: height 8 mm., diam. 13.5 mm.; 5½ whorls.

P. SUDENSIS CYPRIA (Kob.). Pl. 25, figs. 17.

"Differs from the type by the slightly larger shell, more widely umbilicate, more depressed, lightly flattened below, aperture ovate, the lower margin of the lip straightened. Diam. 15 mm., min. 14 mm., alt. 8 mm." (*Kobelt*).

Cyprus, in several localities (H. Rolle).

Patula sudensis var. *cypria* KOBELT, 1897, Rossmaessler's Iconogr., n. F., Erster Supplement-Band, p. 56, pl. 22, f. 5-7.

Kobelt further states that this agrees most closely with the Cretan *P. sudensis*, especially in the size and sharp ribbing, the wide umbilicus and the widening of the last two whorls.

It is flatter, the lower side especially flattened, the umbilicus is wider, the basal margin nearly straight; the whorls increase more rapidly than in the type, etc. I have not seen this form, which from the above account seems to me except in size to have more the characters of *erdeli* than of *sudensis*.

Genus PYRAMIDULA Fitz.

Pyramidula Fitzinger, 1833, Syst. Verzeich. Oesterreich Weichthiere p. 95, for *Helix rupestris* Drap.

For anatomy see: Soos, 1917, Ann. Mus. Nat. Hungarici vol. 16, pp. 114, 160, f. 88, 89.—Hesse, 1918, Nachrbl. D. Malac. Ges. vol. 50, p. 110.—Watson, 1920, Proc. Malac. Soc. Lond. vol. 14, pp. 6-30, f. 4*a*, pl. 2, f. 1, 3, 4.

Shell small (diam. between 2 and 4 mm.), turbinate or depressed with conic spire, of 4 to 5 strongly convex tubular whorls and moderate or wide umbilicus; aperture toothless; peristome simple, the columellar margin somewhat expanded.

Jaw very thin, delicately striate. Radula with centrals about as wide as the laterals, tricuspid with very small ectocones (Watson), or unicuspid (Soos, Wiegmann); laterals bicuspid; marginals wide, pectinate, with numerous narrow cusps, no entocones.

Reproduction ovo-viviparous; penis enlarged distally (see below), the penial retractor inserted on the vas deferens (epiphallus ?); prostate gland of few tubules, posterior; spermathecal duct rather short; neck of uterus and vagina about equal in length (Pl. 29, fig. 2, *P. rupestris*, after Watson).

This genus inhabits the southern part of the Palæarctic Region from Spain to Japan. Only a few species are recognized. Possibly a few others included by Pfeiffer (Nomencl. Hel. Viv.) in *Patulastra* may turn out to be Pyramidulae, but most of the minute ones seem to belong to *Punctum*. The type of *Patulastra* is *Helix pygmaea* Drap., designated by Kobelt, 1880.

The several accounts of the anatomy of *P. rupestris* differ somewhat, so that Watson intimates that different species are involved. Fritz Wiegmann, quoted by Hesse, states that the penis was undeveloped in his specimens, its *Anlage* having a

length of 0.4 mm., consisting of a somewhat curved, club-shaped, blunt body, which receives the vas deferens at about the distal third, the penial retractor inserted on the vas deferens. Soos described the penis as remarkably small, fusiform, distally recurved upon itself, the two parts lying close together; tapering suddenly into the very long, thread-like vas deferens; the weak retractor inserted on the thickest part of the penis. Watson, whose figure is copied in Pl. 29, fig. 2, says "penial appendix much reduced, being represented by a mere knob, without muscular attachment". It appears to me very doubtful whether the distal enlargement of the penis is correctly considered to be homologous with the appendix of *Vallonia*, etc.; Soos' figure does not show it, though he mentions that the transition from penis to vas deferens is abrupt. The male organs seem to be very similar to those of some Vertigininae, such as *Columella* as figured by Steenberg (1925, p. 100).

According to Moquin-Tandon the uterus contains 3 to 7 embryos; Watson's figure shows 2 or 3. Both Wiegmann and Soos report not more than one in the specimens they opened.

Wenz (1923, Fossilium Catalogus, p. 1062) recognizes two Tertiary species:

P. ANTONINI (Michaud, 1862), Pliocene, Hauterive (Drome).

P. SUBTERES (Clessin, 1877), Upper Mioc., Undorf bei Regensberg.

Helix (*Patula*) *recurrecta* Oppenheim, 1890, from the Eocene of Monte Altissimo, Prov. Vicenza, perhaps belongs here; see also p. 12.

PYRAMIDULA RUPESTRIS (Drap.). Pl. 25, figs. 9, 9*a*, 9*b*.

The low-conic shell is openly umbilicate (the umbilicus contained about five times in the diameter), hazel or russet, glossy, finely, irregularly striate, the initial 1½ whorls microscopically granulose; composed of 4 strongly convex whorls, which are flattened below the deeply impressed suture. The aperture is basal, oval, the thin peristome expanded a little at the columella. Parietal callus transparent, very short. Height 1.8 mm., diam. 2.3 mm.

Middle and southern Europe, type localities Castelnau and Arbois, in southern France. Algeria; Tunis; Syria. Generally on limestone rocks.

Helix rupestris Draparnaud, 1801, Tabl. Moll. Fr. p. 71; Hist. Nat. Moll. terr. fluv. France, p. 82, pl. 7, f. 7-9.—Pfeiffer, Monogr. IV, p. 71. — Westerlund, 1889, Fauna, Helix, p. 13.—*Helix rupestris* mut. *rupicola* Stabile, 1859, Prospetto Moll. terr. fluv. Lugano, pp. 21, 51.—*Helix rupestris* Drap., Bourguignat, 1864, Malac. Algérie I, p. 184, pl. 16, f. 24-27; with Var. *conoidea* on expl. pl. 16, f. 31-33; *Helix scotaea* Bgt. in coll. stated to be the same, p. 186.—*Helix rupestris* var. *meridionalis* Issel, 1870, Bull. Soc. Malac. Ital. III, p. 115.—*Helix* (*Patula*) *jaenensis* Clessin, 1882, Malak. Bl. n. F., V, p. 187, pl. 4, f. 3.—*Helix rupestris* var. *pinii* Adami, 1886, Bull. Soc. Veneto-Trentina Sci. Nat. III, p. 172. —*Patula rupestris* Drap. var. *dalmatina* Clessin, 1887, Malac. Bl. n. F., IX, p. 51.—*Helix umbilicata* Montagu, 1803, Test. Brit. p. 434, pl. 13, f. 2.—Pfeiffer, Monogr. I, p. 86; Conchyl. Cab. pl. 89, f. 32-35.—*Turbo myrmecidis* Scacchi, 1833, Osservazione Zoologiche I, p. 11 (not seen).—*Helix aliena* Zgl., Pfeiffer, 1841, Symbolae ad Hist. Hel. I, p. 39.—*Helix spirula* Villa, 1841, Dispositio Syst. Conch. Coll. Villa, p. 56 (Prov. Comensi). — *Delomphalus rupestris saxatilis* Hartmann, 1842, Gasterop. Schweiz, p. 122.—*Helix rupestris* forma *subglobosa* "Bgt." Westerlund, 1889, Fauna Palaarct. Reg. Binnenconch., Helix p. 14 (was not named by Bourguignat. Westerlund evidently refers to Bourguignat's "var. C", which that author considered to be typical *rupestris* of southern Europe, giving the distribution as from Spain to Beirut, Syria).—*Pyramidula rupestris* Drap., Kennard & Woodward, 1926, Syn. Brit. Non-mar. Moll., p. 103 (synonymy).

This common and widely spread species varies in size, degree of elevation, width of the umbilicus and in sculpture. I have made no study of its variations and races, but note the following, the characters given being taken from the several authors.

Var. *saxatilis* Hartm. Differs from true *rupestris* by the larger size, flatter shape and wider umbilicus. 2 x 3 mm. Württemberg near Waldhausen, cliffs of Ehningen, etc. A specimen from Lausanne which I refer to this race measures, 1.7 x 2.7 mm., umbilicus one-third the diameter. Pl. 25, figs. 10, 10*a*.

Var. *rupicola* Stabile. Shell more conic, umbilicus narrower. Massagno and Mont S. Salvatore, Lugano. A specimen from Pisa measures 2.3 x 2.5 mm., umbilicus 0.5 mm. Pl. 25, fig. 8.

Var. *scotaea* Bgt. Pl. 25, figs. 6, 7, after Bgt. Conoid-globose, the umbilicus small. 3 x 3.5 mm. Constantine, Bou-Mécid; Bougie; the only variety which has been found in Algeria (= var. *conoidea* Bgt. not *H. conoidea* Sowb.).

Var. *meridionalis* Issel. Spire more elevated, umbilicus very narrow. 2.5 x 2.5 mm.; 5 whorls separated by deep suture. Monte Sant' Angelo, Ferentillo, Umbria.

Var. *jaenensis* Cless. Conoid-turbinate, deeply and widely umbilicate, higher than wide. Alt. 2.5 mm., diam. 2 mm., 5-5½ rounded whorls. Jaen, Spain.

Var. *dalmatina* Cless. More highly coiled and more globose. Dalmatia: cliffs over the source of the Jedrobach and in the Cettina valley near Almissa.

Var. *pinii* Adami. Shell larger, pyramidal, strongly striate, the suture extremely deep, whorls more rounded. Diam. 3-4 mm., alt. 2.3 - 3.3 mm. Mt. Baitone, Bergamasque Alps, on schistose and granitic rocks.

Helix rupestris var. *trochoides* (Férussac, Tabl. Syst. p. 40 (44), not defined; said to be from Castelnau, one of Draparnaud's localities for typical *rupestris*) Paulucci 1879, Fauna Malac. Calabria, p. 64; also 1881, Bull. Soc. Malac. Ital. VII, p. 85, referring also to Férussac, Hist. pl. 80, fig. 3, "la variété conoide." That figure represents a specimen somewhat higher than wide. Mme. Paulucci placed var. *meridionalis* Issel in the synonymy of *trochoides* Fér.; but the name cannot fairly be ascribed to Férussac, since it was not connected with his later figure until Mme. Paulucci made that inference in 1879.

Helix rupestris var. *trochoides* Kreglinger, 1870, Syst. Verz. Deutsch. Binnen-moll. p. 55, defined by the single word "*elevata*", may be the same. No definite locality given.

Probably the above names *rupicola, meridionalis, trochoides* and *dalmatina* were applied to forms scarcely if at all distinguishable. My pl. 25, fig. 8, from Pisa, represents this

high type of *rupestris*. Whether the high-conic Hispanic *jaenensis* is directly related to these forms of the Alpic center is doubtful.

Anatomical considerations suggest that *rupestris* of authors includes more than one species, but those who have published dissections of these snails have not given the shell characters of material used. Correlation of the anatomic data with conchological racial characters given above is therefore impossible at present. The variations and races of *rupestris* stand much in need of revision by some European investigator, as only short-range local views have been published.

PYRAMIDULA RUPESTRIS CHORISMENOSTOMA (Blanc & Westerl.).
Pl. 25, fig. 11.

Shell turbinate, delicately transversely striate, rufous-brown, whitish at the aperture, widely and deeply umbilicate; whorls 4½, the upper subcylindric, flattened at the suture, the penult subangulate in the middle, the last whorl depressed subcylindric, wholly or in part free in the manner of *Vermetus*. Aperture subcircular [or oval], peristome simple, acute, straight. Diam. 2.5 mm., alt. 2.25 mm. (*Westerl.*).

Greece: Syra, around the village of St. Georges, on the inner faces of piles of stones with *Lauria umbilicata* (Roth); Macolessos, Beotia.

[*Helix rupestris*] subspecies *chorismenostoma* BLANC & WESTERLUND, 1879, Aperçu Fauna Malac. de la Grèce, p. 32.

A Beotian specimen is figured.

PYRAMIDULA RUPESTRIS PRZEVALSKII Lindh.

Differs from the type by the larger shell with less convex base, the umbilicus narrower, nearly cylindric, not dilated below; spire much higher for the width of the shell. Shell narrowly umbilicate, turbinate, depressed, thin, striatulate, deep reddish corneous. Spire conoid, the apex rather obtuse; suture impressed; umbilicus narrow, penetrating, nearly cylindric, scarcely dilated at the base. Whorls 4¼ to 4½, rounded, slowly and regularly increasing, the last distinctly

subangular, scarcely descending in front. Aperture rounded-lunar, oblique; peristome simple, straight, the margins distant, columella a little reflected. Alt. 2.8-3 mm., diam. 3-3.25 mm. (*Lindholm*).

Eastern Turkestan: Keria Mts. at 10,400 ft. (N. M. Przevalski).

Pyramidula (*Pyramidula*) *rupestris* Drap. subsp. *przevalskii* Lindholm, Annuaire du Mus. Zool. de l'Acad. Sci. de la Russie, vol. 23, p. 256.

Lindholm further notes that var. *conoidea* Bgt. reaches similar size but has the bodywhorl quite rounded and the umbilicus more open towards the base. The north Indian *P. humilis* has a much more depressed shell and a larger umbilicus.

Pyramidula hierosolymitana (Bgt.). Pl. 25, figs. 12, 13.

Shell very small, narrowly perforate, globose-conoidal, very sharply striatulate, brownish-corneous; 4 convex whorls, increasing regularly; suture deeply impressed; last whorl rounded; the small perforation narrow. Aperture obliquely rounded; peristome simple and acute, the columellar margin reflected subdeflexed in the umbilical perforation; margins approaching, slightly separated by the last whorl. Alt. 2¼ mm., diam. 2½ mm. (*Bgt.*).

Palestine: Valley of Jehosaphat, under the sun-baked stones of tombs, rather abundant (Saulcy); valley of Hinnon (Roth).

Helix hierosolymitana Bourguignat, Testacea Novissima quae Saulcy in itinere per Orientem coll., p. 13; Cat. Moll. Saulcy, 1853, p. 22, pl. 1, f. 32-35.—Kobelt, 1877, Rossmaessler's Iconogr. vol. 5, p. 93, f. 1416.

It differs from *P. rupestris* by the much narrower umbilicus. Bourguignat's figures are copied.

Pyramidula conica Pils. & Hir. Pl. 23, figs. 3-3*c*.

Shell umbilicate, conic, rather thin, amber-brown with a slightly olivaceous tint, slightly translucent. First 1½ whorls smooth, with rather shallow suture; the rest closely, finely and

rather irregularly striate. Whorls 4½, very convex, separated by a very deep suture, the last rounded at the periphery and beneath. Aperture oblique, rounded, about one-fourth of the circumference excised at the parietal wall by the preceding whorl; peristome simple and thin, the columellar margin a little dilated. Umbilicus perspective, contained 3½ times in the diameter. Alt. 1.3, diam. 2.8 mm.

Japan: Suimura, Awa, Shikoku. Types no. 83884, A. N. S. P.

Pyramidula conica Pilsbry & Hirase, 1902, Nautilus XVI, p. 77.

This species is excessively similar to the common European *P. rupestris*, and in separating it specifically I was somewhat influenced by the enormous distance of its habitat from the range of the European species. Lately, however, a form of *rupestris* has been traced into high Asia, *P. r. przevalskii* Lindh., in Eastern Turkestan, about lon. 81 E. This is still a long distance from Shikoku, in E. lon. 134. It is probably best to treat the insular Japanese form as distinct from the European, pending a comparison of the anatomy. It differs by the more tubular, less depressed last whorl and rounder aperture.

In this connection it may be well to notice some Chinese snails described as Pyramidula. *Pyramidula* (*Patula*) *peipinensis* Ping & Yen, 1932 (Bull. Fan Mem. Inst. Biol. III, No. 2, p. 25) is either a *Hippeutis* or a small northern form of the common "*Planorbis*" *umbilicalis* Bens., which has a shell like *Hippeutis*, but may be a toothless *Segmentina*. *Pyramidula* (*Patulastra*) *grabaui* and *P.* (*P.*) *gracilis* Ping & Yen, 1933 (same Bulletin, vol. IV, No. 6, pp. 263-6), are Zonitidae.

Pyramidula humilis (Hutt. & Bens.). Pl. 23, figs. 1, 1*a*, 1*b*, 2.

Shell small, convexly depressed, corneous, broadly and deeply umbilicate; whorls 5, rounded, the last subangulate, the penult slightly interrupts the circular aperture; peristome acute. Diam. 0.125 inch. (*Benson*).

India: Simla (type loc., Hutton) and Chur (Stoliczka); Landour (Benson); Murree (Stol.); Tandiana (Theobald).

Helix humilis Hutton, Hutton & Benson, 1838, J. A. S. Bengal, vol. 7, p. 217.—Pfr., 1847, Monogr. I, p. 106; Conchyl. Cab. Helix III, p. 332, pl. 129, f. 28.—Hanley & Theobald, 1874, Conch. Indica pl. 61, f. 4-6. — Nevill, 1878, Second Yarkand Mission, Moll., p. 18.—*Pyramidula humilis* Pilsbry, 1903, Man. Conch. IX, p. 44.—Gude, 1914, Fauna British India, Moll. II, p. 43.

The embryonic shell of 1½ whorls projects somewhat; it is glossy, with the faintest traces of granulation, the first whorl being wide, the suture only lightly impressed. Subsequent whorls are dull, brown, with irregular, somewhat thread-like striae and a very deeply impressed suture. The last whorl has the periphery above the middle; it is distinctly though bluntly angular in immature shells (fig. 2), but the angulation is almost lost on the last whorl of adult shells. The umbilicus is widely open, occupying one-third or more of the diameter of the shell. A Landour specimen received from Benson measures: height 1.4 mm., diam. 2.3 mm.; 4⅓ whorls.

Two species of *Punctum* are noticed below because they had been figured on Plate 23 under the impression that they were Pyramidulae. Probably all *Punctum* show spiral lines. The species appear to be distributed throughout much of the Holarctic realm and into the tropics in Mexico. The South African "*Trachycystis*" *hottentota* M. & P. has the appearance of *Punctum*. In the Atlantic Islands the genus is represented by *P. pusillum* (Lowe) and *P. placidum* (Shuttl.). The European species have been described by Westerlund, 1889, but his list contains various heterogeneous elements.

Punctum orphana (Heude). Pl 23, figs. 5-5*c*.

Shell umbilicate, orbicular, depressed-conoid, rufous, plicatulate-striate, the spire depressed; whorls 4, slowly increasing, somewhat convex, joined by a rather deep suture, the last cylindric, at the periphery indistinctly subangular, not descending; aperture subcircular, nearly straight, peristome

simple, the columellar margin dilated a little; umbilicus wide, perspective. Alt. 1. 5 mm., diam. maj. 2.5 mm., min. 2.25 mm. (*Heude*).

China: Shanghai, under fallen bamboo leaves, abundant (Heude); Soo-chow (Teng-Chien Yen).

Helix orphana Heude, 1882, Mém. Hist. Nat. Emp. Chinois: Notes Moll. terr. Vallée Fleuve Bleu, p. 21, pl. 13, f. 18.

The animal is black. It is found in many bamboo thickets. Collected in the orphanage of the mission at Shanghai.

My figures are from a specimen received from Père Heude. The dentition has not been examined, but from the presence of microscopic spiral striae I think that it is a species of *Punctum*. The shell figured measures, height 1.65 mm., diam. 2.6 mm.; 4 whorls.

Punctum micra (Pils.). Pl. 23, figs. 4, 4*a*, 4*b*.

The spiral striation, not represented in the figures, is as described for *P. orphana*. The specimen figured measures: height 1.4 mm., diam. 2.1 mm.

Korea: Bay of Ulsan (Kuroda).

Pyramidula micra Pilsbry, Proc. A. N. S. Phila. 1926, p. 469, pl. 35, f. 1, 1*a*, 1*b*.

Review of the anatomy of Pupillidae and related groups.

By H. Burrington Baker.

The systematic inferences from these few notes on anatomy are aired with many misgivings; any deductions based on the animal alone would be weak and this would be especially true of a group in which the shell characters, so far as my slight knowledge goes, appear manifest while those of the soft parts are difficult to study and still more so to evaluate. Personally, I am more inclined towards Watson's (1920) broad limits of the Pupillidae than towards the other extreme proposed by Steenberg in his exquisitely careful "Études" (1925); to me, the total range of anatomical differentiation seems much less than in most families of pulmonates. Incidentally, the male genitalia of these Orthurethra go through strikingly parallel modifications to those in the sigmurethrous Sagdidae (which I happened to study simultaneously, like Steenberg the Clausiliidae); in these, the appendicular arm functions as the apex of the penis. Finally, one must not forget that the soft parts of a large majority of the species and even of the genera and subgenera are still unknown. A tentative outline of the relationships between the subfamilies may be expressed in the form of a key, with many derivative conditions omitted, as follows:

A. Valloniinae (?); shell more heliciform, without teeth [unless *Strobilops* (p. 2) or *Spelaeodiscus* (vol. 27, p. 180) be included]; radula with fundamentally bicuspid laterals and marginals but last with ectoconal accessories; penis (when present) well differentiated.

1. Penis bifid and sharply separated from its epiphallus and appendix; prostate and spermatheca short.
   a. Shell dominantly calcareous and with more or less thickened and expanded peristome..... *Valloniinae.*
   b. Shell dominantly epidermal, often with membranous excrescences; peristome usually thin
   Acanthinulinae.

2. Penis without appendix; shell endodontoid (more like b).

c. Appendicular penial arm vestigial; prostate and spermatheca short.....*Pyramidulinae.*

d. Penis short and simple; epiphallus strong with prominent papilla; prostate and spermatheca longer *Pleurodiscinae.*

B. PUPILLINAE (?); shell more pupiform, usually with pupilloid teeth (vol. 24, p. vii); radula as in A; penis usually strong; inferior tentacles usually present.

3. Oviducal cul-de-sac absent; prostate very short; penis and retractor bifid, although epiphallar arm weakly demarcated; shell with few or extravagantly developed teeth .....*Pupillinae.*

4. Oviducal cul-de-sac short; prostate long; penial retractor (at least) undivided; penis with modified apex prolonged beyond epiphallar entrance; shell with angular lamella (when present) short .....*Orculinae.*

5. Oviducal cul-de-sac long; prostate fairly long; penis and retractor undivided, with epiphallar entrance near or at apex, which is not modified; shell usually with longer angular lamella .....*Gastrocoptinae.*

C. VERTIGININAE (?); shell as in *B*, but usually minute with prominent epidermis; radula usually with fundamentally tricuspid teeth and with interstitials prevalent throughout; penis usually weak; prostate very short; inferior tentacles (always ?) obsolete.

6. Penis with appendix and with bifid retractor *Nesopupinae.*

7. Penis without appendix and with undivided retractor *Vertigininae.*

In the preceding treatment, complexity of male genitalia and lack of shell armature have been considered convergent characters, which are combined in the Valloniinae (sens. lat.), specifically in the groups Valloniinae (s. s.) and Acanthinulinae. From this standpoint, simplification of the genitalia is secondary and is usually accompanied by development of

shell armature. [The Pyramidulinae and the Pleurodiscinae are exceptions to this general rule and may represent the most primitive conditions, before the evolution of complex genitalia.]

From the Valloniinae, a line (or progressive tendency), usually with more calcareous shells, terminates in the Gastrocoptinae, which have simplified male genitalia and usually develop complex shell armature, but which retain, except in *Modicella*, a radula similar to that in *Vallonia*. On the other hand, from the Acanthinulinae, a divergent line, usually with more epidermal shells, terminates in the Vertigininae, which also have simplified male genitalia and usually develop shell teeth, but which tend to produce interstitial cusps (and entocones) throughout the radula. This idea may be represented graphically as in fig. 10.

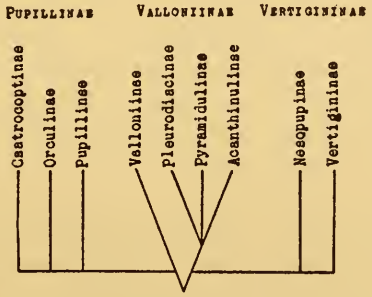

Fig. 10.

An alternative hypothesis would be to consider complexity of shell armature and simplicity of genitalia as the convergent characters. This would bring the Vertigininae and the Gastrocoptinae together but would separate the Valloniinae (s. s.) from the rest of the Valloniinae (sens. lat.) as the terminals of the two divergent lines.

Strobilopsidae.

The only reason for the retention of this group as a family distinct from the Valloniinae lies in its shell characters, es-

pecially its internal teeth. In shell form and in peristome, the sg. *Discostrobilops* approaches *Vallonia*; the principal anatomical distinction of *Strobilops* is the apical prolongation of its penis which somewhat resembles either of the two "diverticula" of *Acanthinula*. In addition, its radular central is about as wide as its first lateral.

STROBILOPS AENEA Pilsbry. Plate 26, figs. 5 to 8.

The animals studied were collected during May, 1928, in Springfield Township, near Philadelphia, Pa.; in most of the individuals of this lot and in all those from Necaxa, Mexico, the vas deferens ends near the base of the spermatheca and the other male organs are lacking. Embryos have not been observed.

Mantle edge (fig. 8) broad; lappets weak; glands encroaching on lung. Lung more than 3 times its base or 4 times length of kidney. Principal vein very close to kidney; weak venation present along columellar side and anteriad. Kidney (broader, longitudinally trabeculate region) about as long as its base or length of pericardium; orthureter about 3 times as long, similarly thick-walled but with weak transverse trabeculae; recurved groove short.

Ovotestis (fig. 7) imbedded in basal end of apical liver lobe; consisting of two lobes, each divided into few, short-clavate lobules; duct thickened below middle in animals with male organs; carrefour clavate with ovoid base; talon not developed. Spermatheca clavate, short-stalked and imbedded in side of oviduct. Vagina very long. Prostate short with clavate alveoli. Epiphallus (fig. 5) developed in vas deferens, some distance above entrance into penial side through a low papilla. Penis bifurcate; appendicular arm clavate and shorter than epiphallar, which extends beyond entrance of vas deferens; appendix elongate fusiform and thin-walled, entering apex of appendicular penial arm through a thickened ring. Penial retractor arising from diaphragm, bifurcating below its middle and inserting near apex of appendicular arm and alongside entrance of vas deferens on epiphallar branch. Atrium short, opening near right inferior tentacle.

Columellar retractor (left) gives off almost immediately the shortly united left free and buccal muscles, soon after the right free retractor and then continues to form the strong tail fan. Right free gives off right ocular, which passes through penioviducal angle, at about level of salivary glands, and divides terminally into fan of short muscles, of which first is inferior tentacular, second goes to vagina and penioviducal angle and remainder to sides of foot.

Cerebral commissure about ⅓ as long as width of each cerebral ganglion; pleural connective medium in length; pedal much longer. Salivary glands long lanceolate, about length of buccal mass but more slender; right one ⅓ to ½ longer than left and completely separate from it; ducts short. Oesophagus long and slender (probably knotted when contracted). Stomach without special gland, but alongside inferior lobe of liver which is narrow and terminally bilobed like in *Vallonia* (Steenberg, 1917) although intestinal S-loops are mainly imbedded in albumen gland. Radular formula (fig. 6): 14 — 1 — (6 + 8), with 83 rows (T).

Strobilops texasiana Pils. & Ferr. Plate 26, fig. 4.

Cf. *S. labyrinthica* Hanna (1922, Naut. 25: 91) and this vol., p. 13.

The animal described was collected June 18, 1929, along the Guadalupe River, north of New Braunfels; the other 23 individuals in the lot lacked terminal male genitalia. All individuals in several lots of the related *S. labyrinthica,* from several localities, are similarly emasculate. Only salient differences from the structure of *S. aenea* will be noted.

Carrefour (fig. 4) enlarged tranversely at apex. Vagina relatively shorter. Epiphallus nearer penis. Penial appendix long clavate (base much contracted). Penial retractor bifurcating near origin from diaphragm; insertion on appendicular penial arm farther from apex.

Valloniinae.

Details of the anatomy of *Vallonia* (oviparous) are given by Steenberg (1917), whose figure of the genitalia in *V. costata*

(Müll.) is reproduced (pl. 29, fig. 1), and by Watson (1920). Neither describes the internal structure of its penis, but its appendix (ap′) appears shorter than in *Strobilops* (less so in Watson's fig.) and one branch of its penial retractor (rc) inserts on the epiphallus (ep). Its radular central is little over half as wide as its 1st lateral.

Anatomical notes on *Spelaeodiscus triarius* (Rossm.) are given by Hesse (1915) and by Soós (1917). If I interpret the latter's figures correctly, its oviduct, spermatheca, vagina, prostate, apical caecum of the epiphallar penial arm and penial appendix must be extremely like those of *Strobilops;* about the only salient differences appear to be the much larger appendicular arm of its penis, the insertion of one branch of its penial retractor below the middle of this appendicular arm, and its radular central, which is about ⅔ as wide as the 1st lateral and appears to have vestigial ectocones. The two genera are also similar in shell form and texture.

On the basis of anatomy alone, I would include in this group *Vallonia, Strobilops* and probably *Spelaeodiscus.*

Acanthinulinae.

This group develops a weak shell with prominent epidermis, which often develops riblets or projections. It may include *Acanthinula, Planogyra, Zoögenetes* and *Spermodea,* although the male genitalia of the last two have not yet been published.

Recent anatomical descriptions of *Acanthinula aculeata* (Müll.) are those of Hesse (1915), Boycott (1917) and Steenberg (1917); Steenberg's figure of the genitalia (oviparous) is reproduced (pl. 4, fig. 6). It has a spermatheca (bc) of the short type and a short vagina (va). Its penial appendix is short, has a terminal sac (ap′) and enters a basal swelling (ap) which looks like the apex of the appendicular penial arm in *Planogyra.* The epiphallar arm (pe′) of the penis is bifid apically, with the epiphallar (ep) entrance between the two "diverticula" (di. di′), and with an insertion of the penial retractor (rc) on one of them.

The female genitalia of *Zoögenetes* (ovoviviparous) are described by Steenberg (1925) and those of *Spermodea* (ovipar-

ous) by Steenberg (1917), Boycott (1917) and Watson (1920); Steenberg's figure of the jaw of *Z. harpa* (Say) is reproduced (pl. 31, fig. 7).

Because of its well-developed appendix, *Planogyra* is added to this group, although its shell form is nearer that of *Pyramidula,* which it also approaches in its undivided penial retractor.

PLANOGYRA ASTERISCUS (Morse). Plate 26, figs. 1 to 3.

P. asteriscus Mse. (1864, Journ. Portland Soc. Nat. Hist. 1: 24), head, jaw and radula (Maine); H. B. B. (1928, Naut. 41: 122), preliminary account.

All my adults, from Cheboygan County, Michigan, have male organs. A very few shells are practically ribless, like in "*Pyramidula rupestris*" *nylanderi* Morse (1920) from Maine, which appears only a form of *P. asteriscus.*

Animal almost white, with short and stout, darkly pigmented ommatophores; inferior tentacles short, lighter in color. Foot holopod but with serrate line formed by upper edges of lowest row of tesselloid bosses quite prominent; short and broad; sole lanceolate with rounded tip, displaying coarse (3 to its length) pedal waves in locomotion. Mantle collar (fig. 3) thick and swollen, protruding beyond peristome, white and very noticeable; pneumostome, guarded by thickenings but without distinct shell-lappets, with anus near inner end. Lung about 2½ times base and 1¾ times length of kidney; principal pulmonary vein near orthureter; rectal surface with inconspicuous venules. Kidney about 1½ times base and twice length of pericardium; trabeculae heavy, becoming transverse anteriad. Orthureter slightly over ¾ length of kidney and much narrower although poorly demarcated; walls with weak transverse trabeculae; opening near anterior end; recurved groove apparently open, also transversely trabeculate, extending backwards shortly beyond apex of kidney.

Ovotestis (fig. 1) imbedded about ¾ whorls from liver apex, consisting of two lobes with few, obovoid lobules; duct long, greatly swollen, convolute in lower half; carrefour hidden by prostate; talon scarcely represented. No embryos observed in

uterus. Walls of free oviduct with longitudinal plicae. Spermatheca ovoid (often more swollen than in figure), imbedded near base of uterine enlargement; stalk medium, columellar in position. Vagina long with structure of free oviduct. Prostate short with few digitate alveoli. Epiphallus (fig. 2) swollen with thick pebbled wall; penial papilla scarcely developed. Penis slender; epiphallar arm short; appendicular arm almost filled by a large papilla, through which appendix opens; appendix of medium length, basally swollen with heavy, transversely trabeculate walls, apically enlarged into a thin-walled sac containing vacuolate mucus. Penial retractor arising from diaphragm and inserting around base of epiphallus (except for heavy muscular sheath, appendicular arm is without retractor, although apex of appendix seems to be loosely bound to diaphragm. Atrium quite short, opening very near base of right inferior tentacle.

Free retractor system much as in *Strobilops* but origin of right free muscle and separation of left free from buccal midway between columellar origin and root of tail. Left free muscle branch to atrium. Digestive system also similar although salivary ducts about as long as glands.

P. CLAPPI (Pilsbry).

The anatomy of animals from near Seattle, Washington, collected Aug. 18, 1929, is very similar to that in *P. asteriscus*.

PYRAMIDULINAE.

The anatomy of the ovoviviparous *Pyramidula rupestris* (Drap.) has been described by Soós (1917), by Hesse (1918) and by Watson (1920); a figure of the genitalia (pl. 29, fig. 2) has been copied from the last. The spermatheca is not much longer than the vagina. The penis appears much simplified although the small diverticulum may represent a vestigial appendicular arm.

PLEURODISCINAE.

Watson's (1920) figures of the genitalia (pl. 29, figs. 3-5) of *Pleurodiscus balmei* (P. & M.) have been copied. Its vagina

is quite short. Its penis proper appears to be small although heavy, with internal pilasters. Its epiphallus is exceptionally well developed with a spirally folded basal part and a longer apical region with longitudinal folds; it opens through a prominent penial papilla. Its simple penial retractor inserts on the side of the basal region of the epiphallus. It is ovoviviparous like *Pyramidula*.

Pupillinae.

The anatomical differences between this subfamily and the Valloniinae seem much less striking than those of the shell. *Pupilla muscorum* (L.) *bigranata* (Rossm.), *alpicola* (Charp.), *cupa* (Jan.) and *triplicata* (Stud.) have been dissected by Steenberg (1925) and his figures of the genitalia (pl. 30, fig. 1) and the jaw (fig. 8) of *P. muscorum* (L) have been copied. The uterus (ut) is distended with embryos. The spermatheca has a variously shaped sac (rs) and develops a cyclindrical diverticulum (di) which is longer in some of the other species. The penis is bifid; its epiphallar arm ($ép_1$) is considerably swollen and extends a short distance beyond the entrance of the epiphallus (ép); and its appendicular arm (ap) is swollen around the base of its appendix (ap_2). The bifid penial retractor (rp) inserts on the epiphallus and near the apex of the appendicular penial arm.

The male genitalia of *Lauria cylindracea* (DaCosta) as figured by Steenberg (1925) are very similar, although the apical caecum of the epiphallar penial arm is better developed (approaching *Orcula*). On the other hand, its spermatheca is much longer and lacks a diverticulum; in addition, the embryos are said to develop only in the free oviduct. However, I would neither create for it a distinct subfamily nor put in a different family from *Orcula* on these grounds.

The anatomy of *Agardhia ferrari* (Porro) has been described in detail by Steenberg (1929) and is similar to that of *Pupilla*. The principal differences are the oviparity of *Agardhia*, its longer spermathecal diverticulum, its shorter vagina, its larger epiphallus which enters at the apex of the epiphallar penial arm, the very short appendicular and epi-

phallar branches (and trunk) of its penis, its long appendix (like *Lauria*) and the peculiar insertions of its penial retractor at the bases of the two penial arms.

Anatomically, *Pupoides* differs from *Pupilla* in the insertion of its penial retractor at the base (instead of on the side) of the epiphallus, in the simpler epiphallar arm of its penis (without apical caecum), by the lack of a spermathecal diverticulum and in the narrower radular central. Its genitalia appear the simplest in the group, but its reduced penial arms approach those of *Agardhia* while its spermathecal stalk, although much shorter, is unbranched like that of *Lauria*.

PUPOIDES MARGINATUS NITIDULUS (Pfr.). Plate 27, figs. 1 and 2.

Cf. *P. marginatus* Pils. (1921, vol. 26: 108).

Among many specimens from the Dutch Leeward Islands, collected during the summer of 1922, one individual from Aruba was found to have mature male organs.

Ovotestis (fig. 1) with three lobes of short-clavate alveoli; duct enlarged and convoluted in lower half; carrefour elongate without distinct talon. Oviduct swollen in apical half; no embryos observed. Spermatheca short, without diverticulum (although a muscle attaches across its stalk below sac). Epiphallus sessile, considerably swollen, internally with longitudinal folds. Penis bifid but epiphallar arm demarcated from epiphallus only by narrower caliber and lack of folds; appendix short, thin-walled, entering penial apex through a thickened ring (like in *Strobilops*). Penial retractor arising from diaphragm, bifurcating a little below its middle to insert around apex of epiphallar arm and near middle of appendicular arm of penis. Right ocular retractor in peniovidueal angle. Radular formula (fig. 2): 16 — 1 — (8 + 8), with 82 rows (T); central much narrower than inner laterals.

The anatomy of *Pupoidopsis hawaiensis* Pils. & Cooke, which has been described and figured by C. Montague Cooke, Jr., and Marie C. Neal (1928), appears to be very similar to that of *Pupoides* but the vagina and atrium are shorter and

the penial retractor seems undivided and attached only to the epiphallus. The radula has a similarly narrow central but fewer laterals and marginals.

Orculinae.

In this group, two species of *Orcula* s. s. (oviparous) have been dissected by Soós (1917) and one by Steenberg (1925), whose figures of the genitalia (pl. 30, figs. 2, 2a) and jaw (fig. 7) of *O. dolium* (Drap.) have been reproduced. Besides the characters mentioned in the key, the spermatheca is very long and stout with its sac (rs) imbedded in the albumen gland (ga). The major portion of the unforked penis forms an apical prolongation (ap), with internal folds, beyond the entrance of the epiphallus (p_1 to p_4); this appears to be a specialized homolog of the apical caecum of the epiphallar penial arm in *Pupilla,* etc.). The true appendix is evidently absent but is present in the following.

In *O. scyphus batumensis* (Ret.) and *O. orientalis* (Pfr.) [*Orculella* Steenberg], of which the anatomy (oviparous) has been described by Hesse (1924), the spermatheca is much shorter, as if the swollen stalk (pd_1) in *O. dolium* had become the functional sac, and the penis has an appendix although an appendicular arm appears to be absent (*batumensis*) or very short (*orientalis*). Also, the swollen prolongation of the penis (or its epiphallar arm) beyond the epiphallar entrance is long (*orientalis,* like in *dolium*) or short (*batumensis*). These species cut down the gap in anatomical characters between *Orcula* and *Lauria* or *Pupilla* considerably and one wonders what an examination of the residual species may show.

Moquin-Tandon's (1855) figure of the male genitalia of *Pagodulina pagodula* (Desm.) does resemble the structures in *Orcula,* as claimed by Steenberg, but new researches are necessary.

Gastrocoptinae.

In this group, *Modicella avenacea* (Brug.) [+ *Chondrina a.*] and *Abida frumentum* (Drap.) have been dissected by Soós (1917); besides these, Steenberg (1925) has studied *M.*

similis (Brug.), *A. partioti* (Moq.), *A. secale* (Drap.) and *Sandahlia cylindrica* (Mich.). From the latter have been taken figures of the genitalia (pl. 30, fig. 3) and radula (text-fig. 11) of *M. avenacea,* of the jaw (pl. 31, fig. 2) of *M. similis,* of the genitalia (pl. 31, fig. 1) and jaw (fig. 3) of *Abida secale* and of the genitalia (pl. 30, fig. 5) and carrefour (fig. 6) of *Sandahlia.*

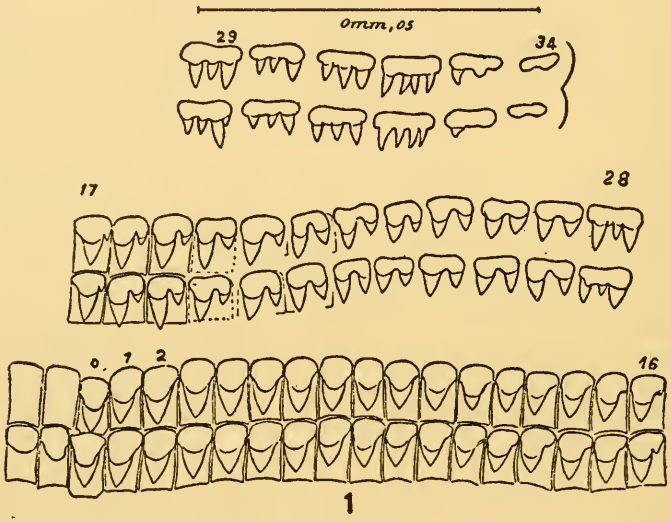

Fig. 11. Modicella avenacea, after Steenberg.

In all these, the spermatheca (rs) is of the short type (imbedded in the uterus) but long-stalked (pd); the uterus (ov) is highly convoluted; the prostate (pr) is about as long as the uterus; the oviducal cul-de-sac is long and cylindrical; the penis (pe) is simple (although with a free apical caecum in some species) and receives the penial retractor (rp) near its middle, which is often connected by fibers to the epiphallus (ep); and the right free retractor sends branches to the base of the penis as well as to the atrium. The unicuspid central and inner laterals of the radula in *Modicella* distinguish it markedly from the other two, which are mainly distinguished by their shell-characters.

Gastrocopta has a relatively smaller although well formed penis and a shorter spermatheca than the other three genera; also, the attachment of its penial retractor is more nearly apical and its tricuspid radular central is narrower than in *Abida* or *Sandahlia*. Their inclusion in the same subfamily is anatomically supported. So far as known, all the genera appear to be oviparous.

Because *Chondrina* Reichenbach (1828) was proposed as a substitute for *Chondrus* Cuvier (1817), the two names are irrevocably inseparable. If Reichenbach's (1836) mention of *Helix avenacea* as the only species be considered either as a type designation or as a definite "restriction" (Cf. Opinion 81), his action applies to *Chondrus* as well, which would become the generic name of *avenacea*. In any case, the term Chondrininae is untenable.

GASTROCOPTA (ALBINULA) ARMIFERA (Say). Plate 27, fig. 5 to 7.

The description is founded on animals from Williams Canyon, near Manitou, Colorado, collected Sept. 19, 1931, but specimens from near Spearfish, South Dakota, collected a week earlier, and from near Philadelphia, collected in the spring, have the same structure. Male organs, although small, seem to be always developed. No embryos have been observed.

Ovotestis (fig. 5) with three lobes of clavate alveoli; carrefour elongate and enlarged at both ends. Oviduct with apical half (uterus) swollen and apically convoluted; basal half slender; cul-de-sac slender and almost as long as uterus. Spermathecal sac imbedded near middle of uterus. Epiphallus (fig. 6) swollen and internally papillate in first half; slender and simpler towards entrance into penis which is without definite papilla. Penis small and slender; swollen apically, where it has thick walls and is prolonged some distance beyond epiphallar entrance. Penial retractor arising from diaphragm and inserting slightly below epiphallus. Atrium short. Right inferior as well as ommatophoral retractors passing through penioviducal and attached to both sides and to vas deferens by slips of muscle; right free re-

tractor with large branch to atrium. Radular formula (fig. 7) : 18 — 1 —(8 + 10), with 82 rows (T) ; central about half width of 1st lateral, with short reflection and 3 small cusps; marginals with prominent mesocone and with few ectocones.

Gastrocopta (s. s.) octonaria Pilsbry. Plate 27, figs. 3 and 4.

The animals are from Bonaire, Dutch West Indies, collected August, 1922; they may be stout examples of *G. curacoana* Pilsbry (teeth of shell destroyed to see animals and vice versa). Only salient differences from *G. armifera* are noted.

Free oviduct (fig. 3) stouter; vagina relatively longer. Epiphallar entrance nearer apex of penis. Radular formula (fig. 4) : 12 — 1 —(4 + 8) ; marginals usually broader and often with more ectocones.

Nesopupinae.

This group is evidently most closely related to the Vertigininae but the gap between it and the Acanthinulinae is almost bridged (except in radular characters) by the genera *Pupisoma* and *Pronesopupa.* Besides these, it includes *Lyropupa, Nesopupa* and *Bothriopupa.* Ovoviviparity appears common and may be universal.

Nesopupa (*Indopupa*) *moreleti* (Brown) has been studied by Steenberg (1925) whose figure of the jaw is copied (pl. 31, fig. 6), and two species of *Pupisoma* by myself (1927) ; in plate 28, figures of the jaw (fig. 3) of *P. mediamericanum* Pils. and of the pallial complex (fig. 5), the genitalia (fig. 4), penis with accessories (fig. 7) and radula (fig. 6) of *P. comicolense* H. B. B. have been reproduced. In *Pupisoma,* the orthureter has a recurved duct. The uterus, filled with embryos, is very long but the free oviduct, spermatheca, vagina and prostate are short. The epiphallus enters through a small papilla into the bifid penis, with its appendicular arm poorly demarcated from the short appendix. The branched retractor inserts on the apices of both penial arms. The jaw consists of narrow, overlapping plates. All radular teeth are fundamentally tricuspid but develop many accessory cusplets. I am now dubious about the presence of inferior tentacles in

Pupisoma; preserved specimens of *Lyropupa* also appear to have inverted ones, each with a definite retractor, although their absence has been observed in living animals.

Pronesopupa (Edentulopupa) admodesta (Mighels). Plate 28 figs. 1 and 2.

Two specimens from Nuuanu, Oahu, collected by Dr. C. M. Cooke, has been so long in alcohol and were so full of embryos that only the penis is figured.

Pallial complex very like that of *Pupisoma comicolense;* recurved ureteric duct closed over for at least part of its length. Female genitalia similar to those of *Lyropupa perlonga,* with large embryos even in vagina. Male organs (fig. 1) exceptionally large. Penis bifid; epiphallar arm demarcated from epiphallus by a swollen constriction; base of appendix with thickened walls and entering through a small papilla. Penial retractor arising from diaphragm and inserting near bases of both appendix and epiphallus. Radular formula (fig. 2): 11—1—(5 + 6), with 106 rows; central tricuspid with an accessory on each ectocone; inner laterals tricuspid with ectoconal accessories; marginals usually fundamentally tricuspid but with many interstitials.

The penial appendix in *Pronesopupa* is better demarcated than in *Pupisoma;* the differentiation of the male genitalia in both genera is in marked contrast to the weak development in *Lyropupa, Nesopupa* and *Bothriopupa.*

Pronesopupa (s. s.) acanthinula (Ancey).

Specimens from Nuuanu, Oahu (Cooke) have the same radular formula and very similar teeth to *P. admodesta.*

Lyropupa (Mirapupa) perlonga (Pease). Plate 28, figs. 10, 11.

A specimen from Luakaha, Nuuanu Valley, Oahu, collected Aug. 3, 1933 by Dr. Pilsbry, has male genitalia.

Ovotestis is in *newcombi;* carrefour (fig. 10) ellipsoid. Uterus of non-gravid example with an apical, spongy swelling, continued by a longer one that appears glassy. Spermatheca of short type with sac imbedded in uterus; vagina quite long.

Prostate short. Male organs small and poorly differentiated; appendix weakly marked off from penial apex; epiphallus apparently entering directly into side of penis. Penial retractor bifid; arising from diaphragm and inserting on appendix and epiphallus. Atrium very short. Radular formula (fig. 11): 10—1—(4 + 6); central half again as broad as 1st lateral, tricuspid but ectocones with one or two accessories; laterals and marginals fundamentally tricuspid but with an increasing number of accessories or interstitials.

The remarkably broad central of *Lyropupa* appears to be its most distinct anatomical character. Its genitalia seem very similar to those of *Nesopupa* as figured by Steenberg (1925).

Lyropupa (s. s.) microthauma Ancey.

An animal from Nuuanu, Oahu (Cooke; ANSP. 117154) has the same radular formula and very similar teeth.

Nesopupa (Limbatipupa) newcombi (Pfr.). Plate 28, figs. 12, 13.

An animal from Kalihi, Oahu (Cooke: ANSP. 117154) has similar (ovoviviparous) anatomy to that in *L. perlonga* and only differences will be noted.

Ovotestis (fig. 13) not lobed, with short-clavate alveoli; carrefour more elongate. Spermatheca longer with sac near apex of uterus. Penial retractor inserting around appendix on apex of its penial arm. Radular formula (fig. 12): 9—1—(4 + 6); marginals often with fewer cusps. Jaw (f. *multidentata*) with 11 plaits; similar to that of *N. moreleti* (pl. 31, fig. 6) in structure.

This species has a broad central like *Lyropupa*. Similar radulae were found in dried-in animals of f. *multidentata* C. & P. from Glen Ada, Nuuanu, Oahu (ANSP. 44717; same formula, with 97 rows) and of *N. kauaiensis* Ancey from Kipu, makai of Gap, Kauai (ANSP. 44743; one more marginal).

Nesopupa (Nesodagys) wesleyana Ancey. Plate 27, fig. 8.

An animal from Kalihi, Oahu (Cooke; ANSP. 117155) has the radular formula (fig.): 10—1—(4 + 6); central and

first lateral subequal; other laterals smaller; marginals broad with numerous interstitials. This is very similar to the radula of *N.* (*Indopupa*) *moreleti* (Brown) as figured by Steenberg (1925) except for his abnormal inner laterals. The central in these two and the next species is very different from that in *Lyropupa* and *Limbatipupa.*

NESOPUPA (NESOPUPILLA) PLICIFERA Ancey.

Four ovoviviparous animals from Nuuanu, Oahu (Cooke: ASP. 117149) lack male genitalia; one gives the radular formula: 12 — 1 —(5 + 7); teeth as in preceding species.

NESOPUPA (COCOPUPA) COCOSENSIS (Dall). Plates 28, figs. 8, 9.

The anatomy of specimens from Wafer Bay, Cocos Island, collected by Dr. Pilsbry on the Gifford Pinchot Expedition, is very similar to that of *N. newcombi* and only differences will be noted.

Vagina (fig. 8) shorter and stouter. Penial retractor scarcely branched although with both insertions. Radular formula (fig. 9): 16 — 1 —(9 + 7) with 106 rows; central and lateral cusps shorter and more aculeate.

The radula of this species looks more like that of *Bothriopupa,* both in relative breadth of the lateral field and in cusp-shape, than like that of the Hawaiian *Nesopupae.* Incidentally, *Ochrodermella,* from the same locality, belongs in the Ferussaciinae (Achatinidae) and has anatomy similar to that of *Neosubulina* from the Dutch West Indies.

BOTHRIOPUPA TENUIDENS (C. B. Adams). Plate 27, figs. 9, 10.

A specimen from foothills behind the reservoir for Port Antonio, Jamaica, collected Aug. 21, 1933, has very small male genitalia (fig. 10). The anatomy (ovoviviparous) is very similar to that in *Nesopupa* and the generic status of the latter must depend on its shell characters.

Radular formula (fig. 9): 13 — 1 —(7 + 6); central and first lateral subequal with slender mesocones and 2-4 ectoconal accessories.

Vertigininae.

In this group, the anatomy of *Columella edentula* (Drap.) was studied by Hanna (1912) and *Vertigo pusilla* Müll., *antivertigo* (Drap.), *substriata* (Jeffr.), *pygmaea* (Drap.), *moulinsiana* (Dup.) and *alpestris* Ald., *Truncatellina rivierana* (Bens.) and *C. edentula* were dissected by Watson (1923). Steenberg (1925) gave more careful accounts of all these except *V. alpestris* and added *V.* (*Vertilla*) *angustior* Jeffr., *T. cylindrica* (Fér.) and *T. costulata* (Nilss.); his figures of the genitalia of *V. pusilla* (pl. 31, figs. 4, 5), *T. cylindrica* (fig. 9) and *C. edentula* (fig. 8) are reproduced, also that of the radula of *C. edentula* (text, fig. 12, 2). Male organs are commonly absent. Oviparity prevails.

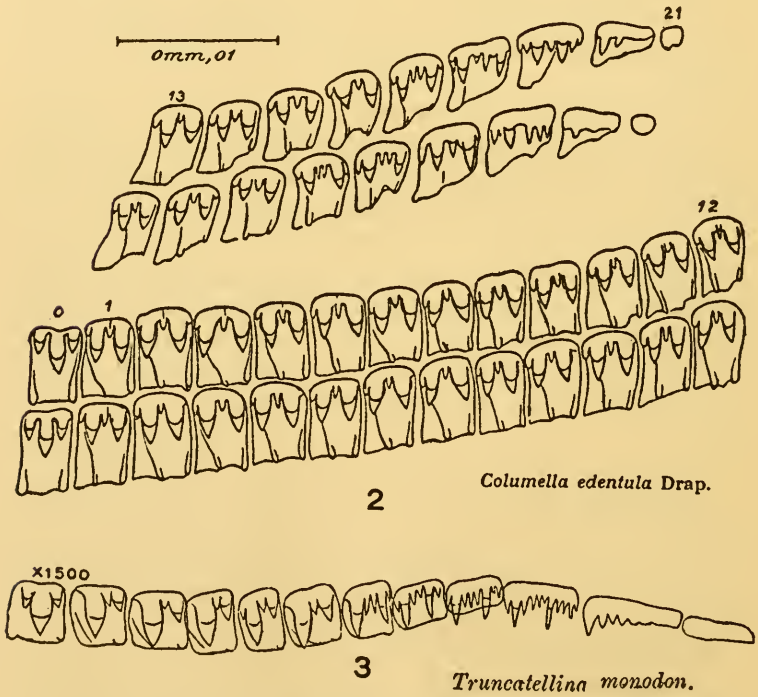

Fig. 12.—2. Columella edentula, after Steenberg. 3. Truncatellina monodon, after Odhner.

The uterus (ov) is simple in *Vertigo* but more or less folded in the other two genera. The free oviduct (ol) is long in *Vertigo,* short or absent in the others. The spermatheca (rs) is of the short type, imbedded in the uterus, but has much the longest stalk in *Vertigo.* The prostate (pr) appears almost vestigial. The epiphallus (ép) is poorly developed but receives the penial retractor (rp) in *Columella* (penial entrance subapical) and in *Vertigo* (entrance apical) but is obsolete in *Truncatellina,* in which the retractor inserts on the penial apex. The radular teeth of *Vertigo* are fundamentally tricuspid and develop numerous interstitial cusplets, but the laterals of *Columella* and *Truncatellina* have only two large cusps and interstitials appear to be lacking on the central (in *Truncatellina* on the inner laterals as well; text fig. 12, 3, *T. monodon* Held, after Odhner, 1924). While *Vertigo* does seem to form a group apart from the others, the differences seem of no more than generic importance.

Bibliography of Papers Cited.

Baker, H. Burrington: 1927, Proc. Acad. Nat. Sci. Philadelphia 79: 223.
Boycott, A. E.: 1917, Proc. Malac. Soc. London 12: 221.
1917, Jour. of Conch. 15: 175.
Cooke, C. Montague, Jr., and Marie C. Neal. 1928, B. P. Bishop Museum Bull. 47: 28.
Hanna, G. Dallas: 1912, Proc. U. S. Nat. Mus. 41: 371.
1922, Naut. 35: 91.
Hesse, P.: 1915, Nachr. Deutsch. Mal. Ges. 47: 55.
1918, Nachr. Deutsch. Mal. Ges. 50: 110.
1924, Arch. Mollusk. 56: 1.
Moquin-Tandon, A.: 1855, Hist. nat. Moll. terr. fluv. France.
Odhner, Hj.: 1924, Arkiv för Zoologi 16, No. 29: 3.
Soós, L.: 1917, Ann. Mus. Nat. Hungarici 15: 1.
Steenberg, C. M.: 1917, Vidensk. medd. fra Dansk. naturh. Foren. 69: 1.
1925, Vidensk. Medd. fra Dansk. naturh. Foren. 80:1.
1929, Vidensk. Medd. fra Dansk. naturh. Foren. 88: 15.
Watson, Hugh: 1920, Proc. Malac. Soc. London 14: 1.
1923, Proc. Malac. Soc. London 15: 270.

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PLATE 26.

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A, penial appendix. C, carrefour. D, vas deferens. E, epiphallus. G, albumen gland. H, hermaphroditic duct. L, radular laterals. M, radular marginals. O, ovotestis. P, penial trunk. PA, appendicular arm. PE, epiphallar arm. PR, penial retractor. PT, prostate. R, radular central. S, spermatheca. T, outline of radular transverse row (right half). U, oviduct (uterus + free oviduct. UC, oviducal cul-de-sac. V, vagina. X, atrium.

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Drawn by H. B. B.

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ap, appendicular arm of penis (penial caecum in pl. 5, fig. 8). ap′ or ap_2, penial appendix. bc, spermathecal sac. cg, cl, atrium. dh, hermaphroditic duct. ep, epiphallus. ep_1, epiphallar arm of penis. ga, albumen gland. gh, ovotestis. ol, free oviduct. ov, uterus. pd, spermathecal stalk. pf, carrefour. pr, prostate. rc, rp, penial retractor. rs, spermathecal sac. ut, uterus. va, vagina. vd, vas deferens.

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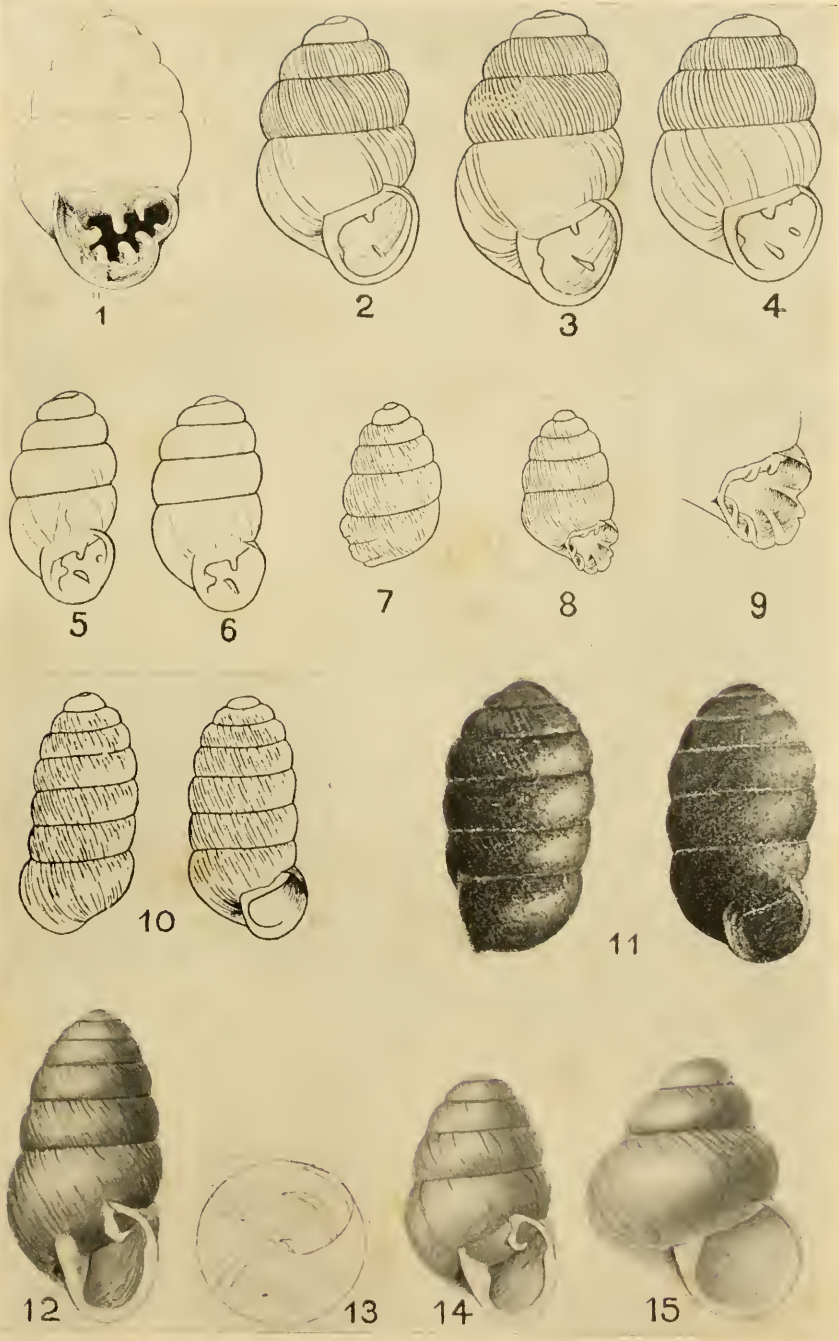
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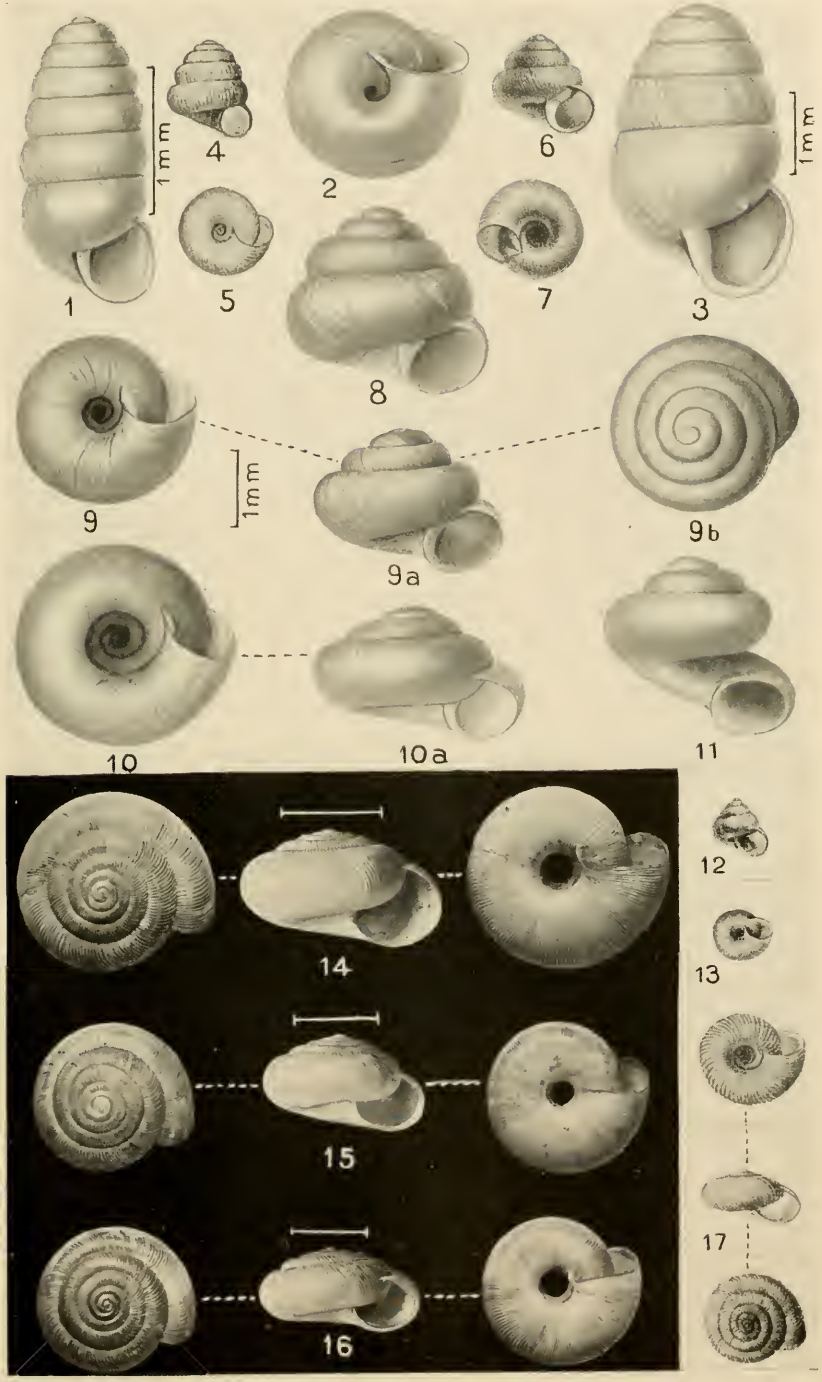
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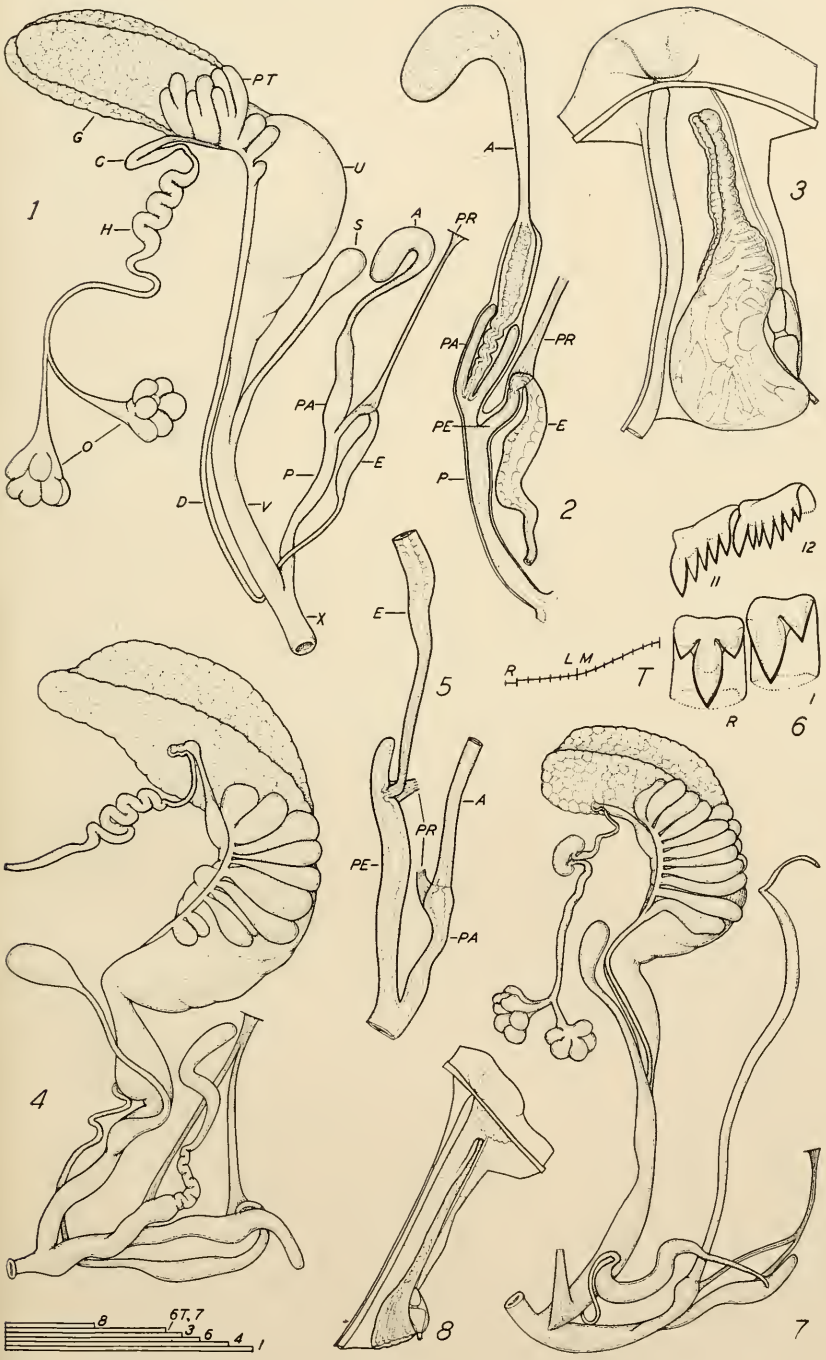
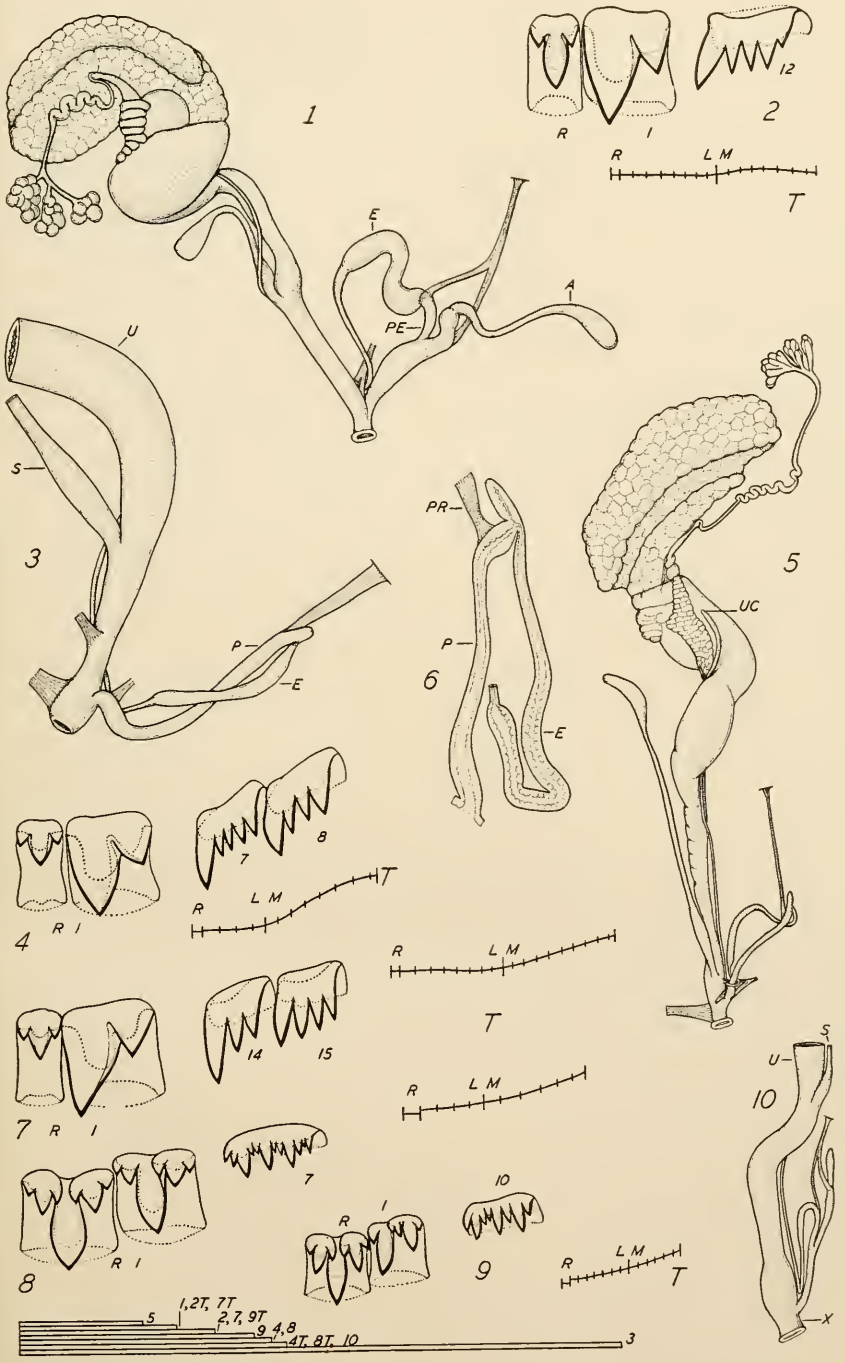
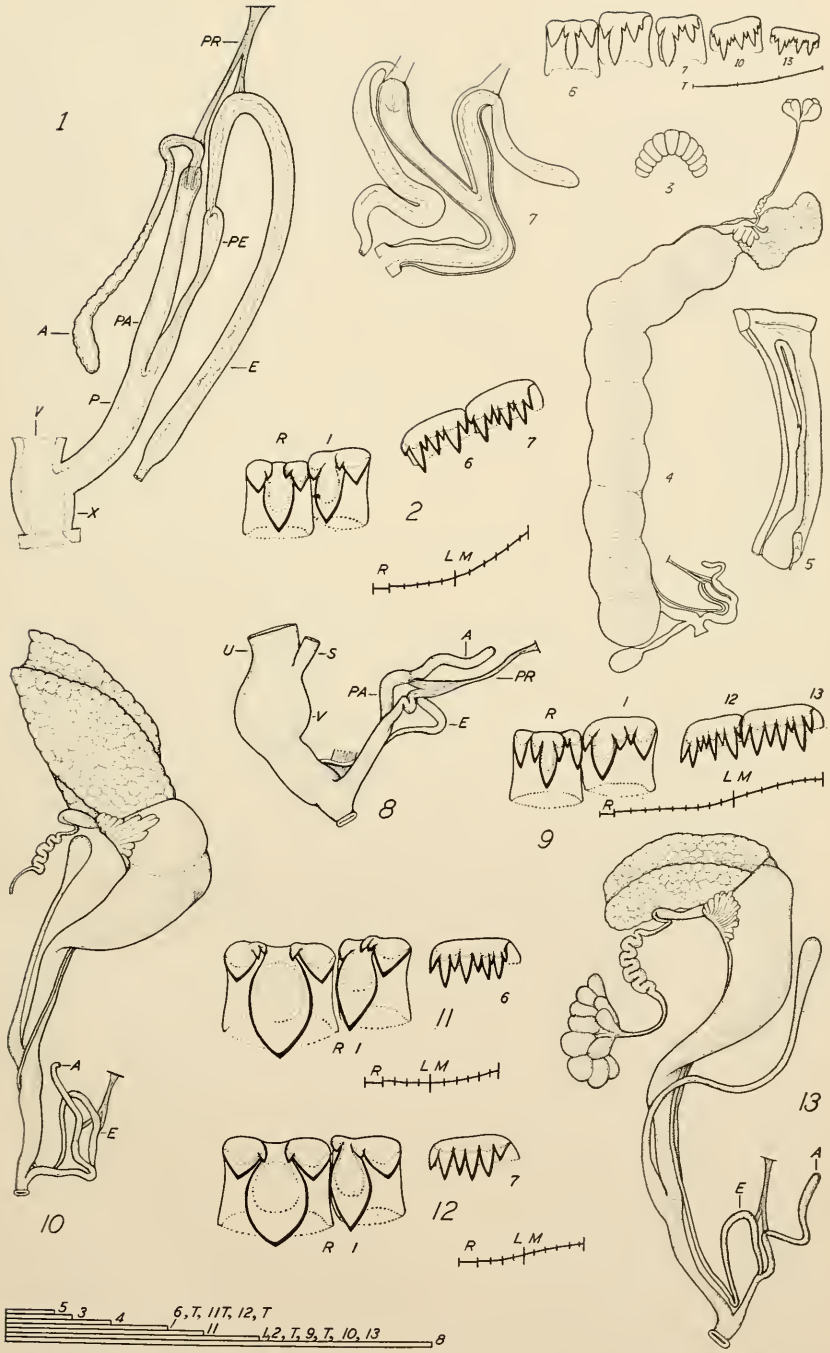


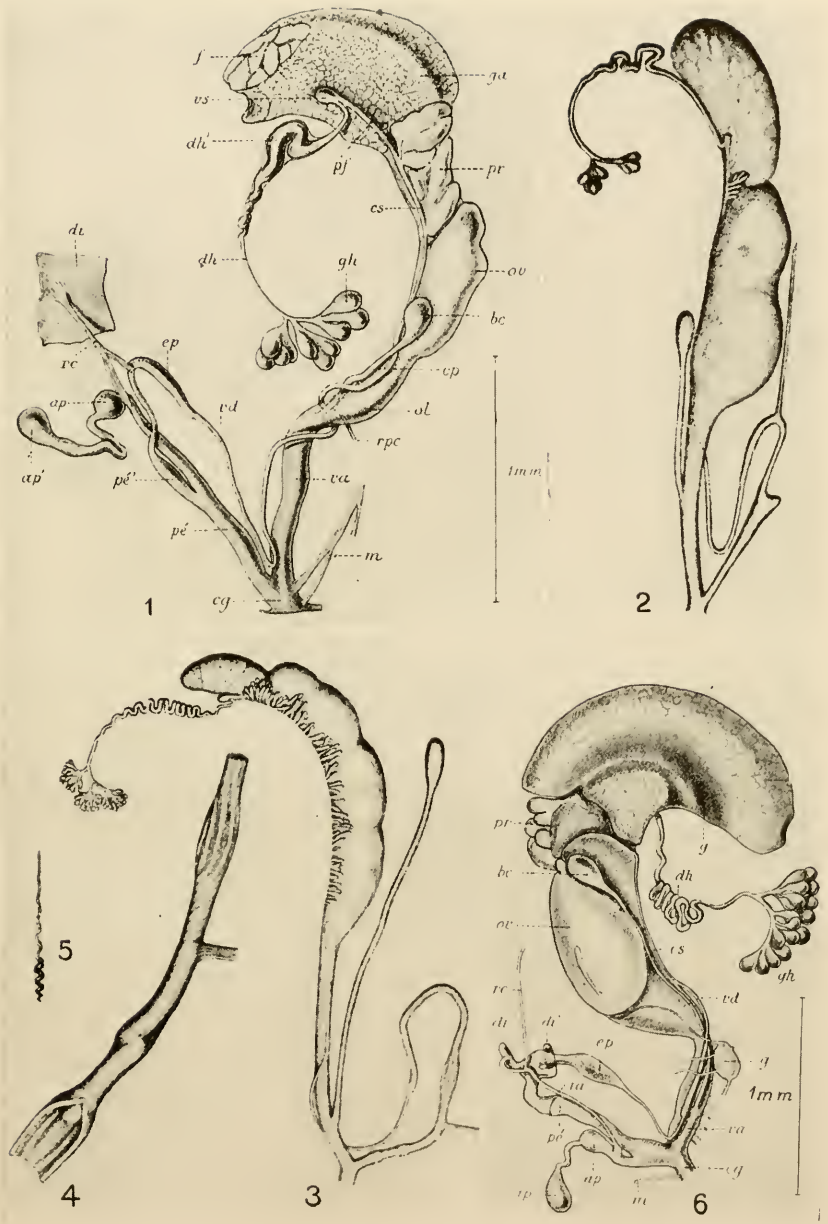
1–3, Planogyra asteriscus. 4, Strobilops texasiana.
5–8, Strobilops aenea.



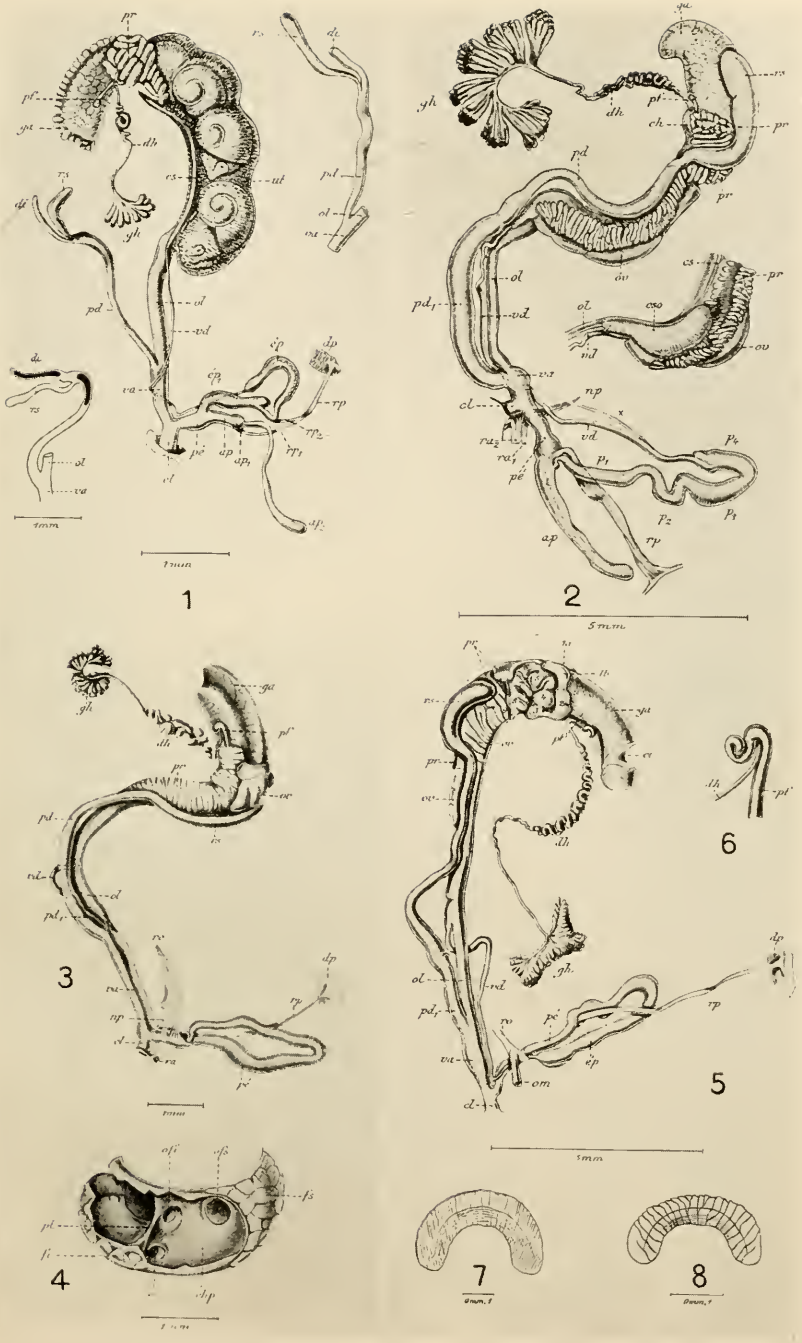
1, 2, Pupoides m. nitidulus. 3, 4, Gastrocopta octonaria.
5–7, G. armifera. 8, Nesopupa wesleyana.
9, 10, Bothriopupa tenuidens.



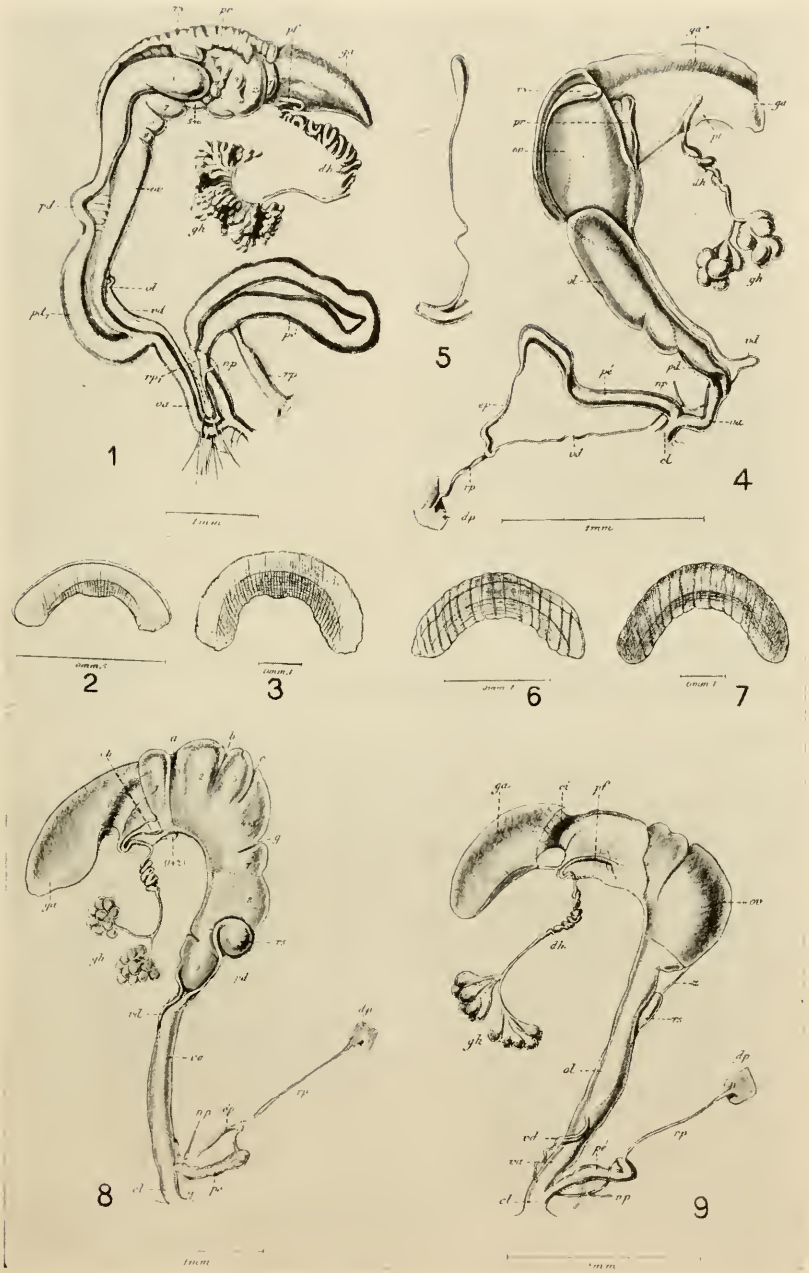
1, 2, Pronesopupa admodesta.
3, Pupisoma mediamericanum.
4–7, Pupisoma comicolense.
8, 9, Nesopupa cocosensis.
10, 11, Lyropupa perlonga.
12, 13, Nesopupa newcombi.



1, Vallonia pulchella. 2, Pyramidula rupestris.
3–5, Pleurodiscus balmei. 6, Acanthinula aculeata.



1, 8, Pupilla muscorum.
2, 7, Orcula dolium.
3, 4, Chondrina avenacea.
5, 6, Sandahlia cylindrica.



1, 3, Abida secale.
2, Chondrina similis.
4, 5, Vertigo pusilla.
6, Nesopupa moreleti.
7, Zoogenetes harpa.
8, Columella edentula.
9, Truncatellina cylindrica.

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